THE ILLUMINATING ENGINEER

LIGHT LAMPS FITTINGS AND ILLUMINATION

THE JOURNAL OF GOOD LIGHTING

OIL · GAS ELECTRICITY ACETYLENE PETROL-AIR GAS ETC.

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LEON GASTER

Born 1872 Died 1928

THE news of Mr. Leon Gaster's unexpected death comes with specially tragic force as this Anniversary Number of the Journal, to which he devoted so great a part of his activities, goes to press. He died on Saturday, January 7th, after a brief illness of only a week.

Mr. D. R. Wilson, President of the Illuminating Engineering Society, has kindly sent us the following message for publication :—

" Full appraisement of his principal life-work—the awakening of interest in illuminating engineering in this country and abroad—must await the issue of a future number. Meanwhile I know that the Council and Members of the Society which he founded nearly 20 years ago would not wish the present occasion to pass without recording their very high appreciation of the invaluable services rendered by him as Hon. Secretary of the Society since its foundation, and expressing their deep sorrow at the loss of one whose personality and charm endeared him to all who knew him."

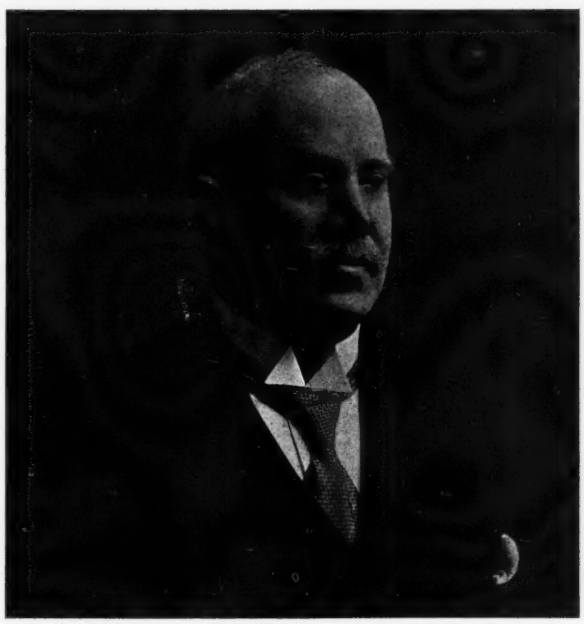


Photo taken by the Wykeham Studios Ltd., Feb., 1926.

We feel sure that these words will be endorsed by all who knew Mr. Gaster—and his name was known all over the world. Our readers may recall that a special record of Mr. Gaster's activities appeared in this journal in January, 1926. Some indication of their scope is also afforded by the brief review of Twenty Years of Illuminating Engineering in the present number.

Besides his association with the Illuminating Engineering Society and its journal, both of which he founded, Mr. Gaster was interested in the work of many other scientific and technical bodies, and he served on numerous committees. He was a member of the National Illumination Commission of Great Britain and of the Executive Committee of the International Illumination Commission; of the Departmental (Home Office) Committee on Lighting in Factories and Workshops, and of the Illumination Research Committee working under the Department of Scientific and Industrial Research. He served on several of the sub-committees established by the British Engineering Standards Asssociation; and he was actively associated with the work of such bodies as the National Safety-First Association and the Association of Special Libraries and Information Bureaux.

Although best known to our readers as the Editor of *The Illuminating Engineer,* Mr. Gaster had many other journalistic interests. He was a Fellow of the Institute of Journalists, and for many years a member of its London District Committee, and he was the life and soul of its Scientific and Technical Circle, of which he was in turn Hon. Secretary and Chairman. He was also the Hon. General Secretary of the British International Association of Journalists, and acted as Hon. Secretary of the great International Conference of the Press which took place in London last year.

His early death is indeed a great loss to the illuminating engineering movement, but we hope and believe that this is now so firmly established that its further progress is assured. We are also confident that all those associated with the movement will make every effort to promote the development of the Illuminating Engineering Society in this country on the lines conceived by its founder—Leon Gaster.

Twenty Years of Illuminating Engineering (1908-1928)

JUST twenty years have elapsed since the first issue of this journal was published in January, 1908, and we are celebrating the event by publishing a Twentieth Anniversary number.

We should like to commence these remarks by thanking all those who have contributed and co-operated in this special effort, and particularly to the writers of the series of messages referring to this event.

That the Illuminating Engineering Society and its journal have survived 20 years of existence is surely an adequate reply to those who, at the historic meeting at the Institution of Engineers-in-Charge in 1907, expressed some doubts as to their practicability. It is not surprising that at that time there should have been some difficulty in conceiving "illuminating engineering" as it is now understood. Methods of lighting were limited. The electric metal-filament lamp had only recently made its appearance; gas lamps in general were much inferior to those available to-day. One feature of the past 20 years has been the steady progress both in efficiency and in the range of candle-powers available. But even more striking has been the development in lighting fittings and appliances of all kinds and in the knowledge of how such devices should be applied.

When the journal was started such terms as "foot-candle," "lumen," etc., were little known. To-day they are familiar, and their exact definition has been settled to a great extent by international consultation. In 1908 there were few illumination photometers available, and photometry was regarded by most people as merely an interesting hobby. To-day the illumination photometer is a familiar apparatus in common use, and it has been found possible to draft a specification outlining its essential features. Illumination photometers form part of the stock-in-trade of leading firms in the lighting industry, and specifications of lighting installations indicating the foot-candles to be provided are furnished as a matter of course. Polar curves of light distribution are likewise embodied in the catalogues of leading firms as an essential description of the performances of their equipment.

Perhaps the most striking change of all, however, has been the revelation of continual new applications of light and of the variety of problems requiring study. Such questions as the lighting of schools, libraries and streets have been dealt with by joint committees. The study of industrial lighting has been taken up with special keenness, and its importance has been recognized by the appointment of the Home Office Departmental Committee on Lighting in Factories and Workshops. Valuable work has been done by the Illumination Research Committee working under the Department of Scientific and Industrial Research. There seems no finality in the problems awaiting solution. And it is surely a significant indication of progress that illuminating engineering should be ripe for standardization—as is illustrated by the useful work being done by several of the B.E.S.A. Illumination Committees.

In all these activities the Illuminating Engineering Society has acted as a "liaison officer," linking together different researches and preventing overlapping of work, whilst its journal has served a special purpose in acting as a centre of information from all quarters and giving publicity to the valuable researches now being conducted.

Developments in this country have been paralleled by activity abroad. In 1908 there was in existence but one Illuminating Engineering Society, that formed in the United States in 1906. The Illuminating Engineering Society in this country was formed early in 1909. The Illuminating Engineering Society in Germany came into existence in 1912. In later years similar societies have been formed in Austria, Hungary, Holland and Japan. Finally, we have the International Commission on Illumination, with national committees in all the chief countries, which, after the inevitable postponement of its labours during the war, has now resumed operations on a fuller scale than ever before.

Doubtless in another ten years there will be many new developments in illuminating engineering, at present unforeseen. Meantime it can be predicted that the next few years will form a period of continually increasing activity, which our journal, with the aid of its correspondents in many countries, will continue to record.

Electric Lighting in the Engineering Industry

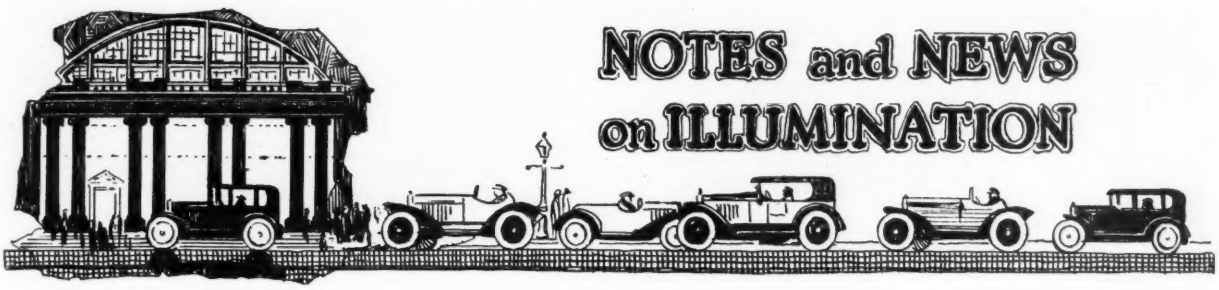
THE series of data presented by Mr. Cooper in his paper before the Illuminating Engineering Society on December 3rd (see pp. 5-15) formed a useful supplement to the corresponding statistics in the field of shop lighting presented by Messrs. W. Jones and H. Lingard in 1925.* Mr. Cooper's investigation, like this previous one, was undertaken for the E.L.M.A. Lighting Service Bureau, and the results are conveniently assembled in tabular form.

From these diagrams a number of conclusions may be drawn. Apparently approximately 80 per cent. of the manufacturers interviewed agreed that good lighting is important. The chief consideration, in their opinion, was the resultant prevention of accidents and the improvement in hygienic conditions rather than increased output. In any case, this widespread recognition of the value of good lighting is encouraging. What is less satisfactory is the analysis of the quality of installations, only 10 per cent. of which were classed as "very good," whilst 50 per cent. were classed as "poor" or "very poor." These two conclusions seem to point to the need for more educational work. There is an atmosphere favourable to improvements, but the essentials of good lighting are not sufficiently understood. This is rather borne out by the further discovery that 70 per cent. of factories use bare gasfilled lamps, and that bowl-sprayed internally-frosted and opal bulb lamps are apparently little used, the prevalent impression being that these absorb too much light.

The paper led to an interesting discussion. It was specially gratifying to have the presence of Mr. E. A. R. Werner and Mr. L. Ward, both of whom referred to the value of the educational work being done by the Society, and contributed most useful summaries of their experience as inspectors of factories. Mr. Werner suggested that there is justification for the use of local lights in many industries, especially as a supplement to general lighting.

We should like to take the opportunity of adding that both the public and the lighting industry are greatly indebted to the Home Office Factory Department and their inspectors for the very sympathetic and systematic attention they have devoted to industrial lighting. There can be no doubt that a considerable amount of the general improvement during recent years is due to their efforts. The field, however, is a vast one, and some time must necessarily elapse before all the main principles of good lighting are generally understood.

* *Illuminating Engineer*, May, 1925.



The Home Office Industrial Museum

An important event last month was the opening of the Home Office Industrial Museum in Horseferry Road, Westminster. The prospective opening of this museum, the first of its kind in this country, was mentioned in the Report of Progress during the Vacation which was presented at the opening meeting of the Illuminating Engineering Society last November. We understand that the members of the Society will have a special opportunity of visiting the museum and hearing a description of the chief exhibits in the near future, and we therefore postpone any detailed account until then. But meantime we should like to draw attention to the very useful nature of this exhibition, which comprises a complete range of safety appliances for industrial work. A special feature is the inclusion of a series of exhibits illustrating good and bad methods of lighting in factories and workshops, which illustrates the importance attached by the Home Office to adequate industrial lighting. The Home Office Factory Department has shown characteristic enterprise by creating this unique museum and special recognition should also be given to the services of the many associations and firms who have contributed specimens of appliances, lighting fittings, etc., to the exhibition.

Good Lighting as an Aid to Safety

A contribution under the above title from the late Mr. L. Gaster appears in the last issue of *Safety First*, the official organ of the National Safety-First Association. It may be recalled that this subject was also dealt with very fully in an illustrated booklet issued by the British Industrial Safety-First Association in 1923. The present article sets out the case for good industrial lighting and refers to recent developments, such as the excellent work being conducted by the Illumination Research Committee of the Department of Scientific and Industrial Research. As is well known, the National Safety-First Association is taking a deep interest in lighting in relation to safety. It is now generally agreed that quite a considerable proportion of industrial accidents are due directly or indirectly to inadequate lighting, and the claim from the economic standpoint as well as the humanitarian one is very strong. Millions of pounds are spent annually in meeting claims under the Workmen's Compensation Act, and it was recently estimated that during the normal year something like 150 million working hours are lost through sickness and accidents. Managers of factories have therefore every inducement to study the welfare of their workers, and good lighting ranks high among the factors contributing to health, safety and efficiency.

Institute of Physics

At a special general meeting of the Institute of Physics on December 16th the Royal Meteorological Society was admitted as a participating society of the Institute.

This is the sixth society to co-operate in this way, so that the aim of the Institute, to co-ordinate the work of existing societies concerned with physics and its applications, is being carried into effect.

Problems in Illuminating Engineering

The meeting of the Illuminating Engineering Society devoted to "Problems in Illuminating Engineering," last year was generally considered a very successful one, and the experiment is to be repeated this month, a meeting on January 24th having been allotted for the purpose. It may be recalled that the feature of such discussions is the presentation, by different contributors, of short illustrated accounts of problems they have met with and suggested solutions. We understand that several interesting problems, including the lighting of escalators and foundries, are already included in the programme. Members in a position to make contributions on other problems are specially invited to communicate with the Hon. Secretary of the Society, 32, Victoria Street, London, S.W.1) in good time before the meeting. We may also remind members that even if they do not feel able to present one of the short introductory papers there will be opportunities for raising supplementary problems in the course of the discussion. We hope, therefore, that members will "store up" for this meeting all the difficulties they have encountered in their work and bring them up for consideration.

Light and Heat in Medicine, Surgery and Hygiene

The conference and exhibition under the above title arranged at the Central Hall, Westminster, during December 13th to 16th proved quite interesting, and attracted a considerable number of visitors. The programme of papers included a number of contributions dealing with the applications of sunlight, amongst which Dr. Leonard Hill's paper on "The Ultra-violet in Sunlight and Artificial Light Sources" deserves special mention. It was, however, rather a disappointment that Dr. William Tibbles's paper on "Light and Vision" was not read, owing to the indisposition of the author. In the exhibits lamps for medical treatment, both of the arc and mercury-vapour lamp, were well represented, and one was struck by the remarkable variety and evidence of special design in apparatus of this description. There were also on view several novel types of lighting units for illuminating tables in operating theatres. We hope to comment more fully on these exhibits in our next number.

The Physical and Optical Societies Exhibition

We are informed that the Eighteenth Annual Exhibition of the Physical and Optical Societies is being held during January 10th to 12th, 1928, at the Imperial College of Science and Technology, South Kensington. The exhibition will be open from 3 p.m. to 6 p.m. each afternoon, and in the evening from 7 p.m. to 10 p.m. It is stated that more than 80 firms are exhibiting, and there will be, in addition, research and experimental exhibits by various Fellows of the Societies and by individual research laboratories, etc. A series of discourses has been arranged, amongst which we note a lecture by Dr. J. W. T. Walsh on "Artificial Daylight" at 8 p.m. on January 12th.

Applications for tickets should be addressed to The Physical and Optical Societies, 1, Lowther Gardens, Exhibition Road, London, S.W.7. Tickets, however, are only required on January 10th and 11th; on the third day (January 12th) no tickets are necessary.

Illumination and Public Safety

As readers of this journal are aware, numerous efforts have been made to establish the relation between lighting conditions and accidents, both in streets and in factories. But it is curious that hitherto relatively little attention has been paid to another important function of illumination—namely, its influence in diminishing crime and promoting public safety. An interesting contribution on this subject from Herr H. Lingenfelser has recently appeared in *Licht und Lampe*. The author is well aware of the many different factors to be considered. Doubtless the most correct method, but one difficult to realize in practice, is to compare the crime statistics for a city or a part of a city in one year with the figures in a successive year after a marked improvement in illumination has taken place. This method was, however, actually pursued in a valuable paper by E. A. Anderson and O. F. Haas, read before the 1921 Convention of the American Illuminating Engineering Society. The paper dealt with the effect of important improvements in public lighting effected in Cleveland in 1916. It was shown that 90 per cent. of cases of burglary occurred during the hours of darkness. The authors reached the important conclusion that in the business area of Cleveland the number of burglaries attained only 60 per cent. of those that would normally have been expected if no alteration in the lighting conditions had taken place.

Some indication of the part played by lighting conditions is furnished by the number of burglaries during different periods of the year. In this connection the following table is presented by Herr Lingenfelser for Berlin:—

Period of Year	Number of Burglaries in:—					Robbery in Streets	Total
	Shops and Offices	Shop Windows, etc.	Various Business Places, etc.	Safes	Vaults and Underground Passages		
Summer Half-year	1,604	675	293	91	758	240	3,661
Winter Half-year	2,184	1,142	532	208	1,087	267	5,420

From these figures the striking conclusion may be drawn that in Berlin cases of robbery and burglary are, on the average, 50 per cent. more numerous in winter than in summer. In this case it can hardly be doubted that the greater period of darkness during the winter months is the predominant factor.

The Automatic Lighting of Aerodrome Landing Areas

According to the *Journal* of the American Institute of Electrical Engineers, a sound sensitive automatic lighting apparatus developed by Mr. T. Spooner, an electrical research engineer, will abolish the necessity of keeping aeroplane landing fields continuously brilliantly lighted all night.

The device uses the drone of the aeroplane to control electrical energy, and a loud speaker operated reversely is the "ear" of the mechanism. The tiny current at first produced is increased by amplifiers until it is sufficiently strong to throw the lighting switch, which automatically locks, and the lights remain on until switched off by a field attendant.

A New System of Tunnel Lighting

According to some information prepared by Mr. Samuel G. Hibben, the new Holland tunnel, which forms a highway between Manhattan Island and New Jersey in the United States, is regarded as the best-lighted subway in the world. Some years ago, when the plans for the lighting of this remarkable tunnel were under consideration, we gave a forecast of the arrangements. With characteristic enterprise Mr. C. N. Holland devoted special attention to the lighting of the tunnel associated with his name. An inspection was made of the methods adopted in similar tunnels in Europe, and the scheme was worked out by the engineers of the Westinghouse Company with the aid of a miniature model. The method finally adopted is based on the use of lamps recessed in boxes, backed by reflectors, and protected by diffusing glass flush with the side of the tunnel. These novel lighting units are placed 20 feet apart, opposite each other—the distance apart being diminished to 10 feet near the entrances to the tunnel so as to "grade" the illumination and diminish the contrast with daylight. An interesting point is that the positions assigned to these units were found to be greatly superior to any system of staggering, which would have caused disconcerting moving shadows. The lighting units are inconspicuous and have no projecting parts, so that breakage is reduced to a minimum. There is a clear view ahead and drivers are not bothered by glare. The illumination is remarkably uniform, the average (measured at a height of 2 feet) being 1.22 foot-candles, the maximum 1.4 and the minimum 1.0 foot-candles. The average consumption works out to 0.75 watt per square foot of road surface. The 150-watt lamps used in the tunnel are mounted in such a way as to provide alternative circuits, supplied from four entirely distinct central stations; possibility of failure of the lighting is thus practically eliminated. The tunnel was opened officially on November 12th last year, and the lighting scheme should be of considerable interest to illuminating engineers in different parts of the world where numerous long tunnels and subways for vehicular traffic exist.

Special Lighting Tariffs in Germany

In Germany there has recently developed a movement in favour of granting special rates for various applications of electricity likely to lead to progress and popularization of its applications. It has been urged in particular that special rates should be granted to organizers of showrooms and demonstration centres. It is argued that every lamp fitting or electrical device sold means more revenue to supply undertakings, who can therefore well afford to encourage their display to the public. According to *Licht und Lampe*, a lead in this direction has recently been given by the Bochum undertaking, which grants special terms for the supply of electricity to demonstration rooms for electrical appliances. Special rates for such purposes as show-window lighting, illuminated signs, staircases, house numbers, etc., are also specified.

Attention is also drawn to several important new lighting installations. Amongst these are mentioned the adoption of floodlighting by the chief terminal railway station of Berlin, whilst Nürnberg has at length released the ban on illuminated signs erected on premises above the first story.

TECHNICAL SECTION

COMPRISING

Transactions of The Illuminating Engineering Society and Special Articles

The Illuminating Engineering Society is not, as a body, responsible for the opinions expressed by individual authors or speakers.

Electric Lighting in the Engineering Industry

(Proceedings at a meeting of the Illuminating Engineering Society, held in the Lecture Hall of the E.L.M.A. Lighting Service Bureau (15, Savoy Street, Strand, W.C.), at 6 p.m. on Tuesday, December 13th, 1927).

A MEETING of the Illuminating Engineering Society was held in the Lecture Hall of the E.L.M.A. Lighting Service Bureau (15, Savoy Street, Strand, W.C.), at 6 p.m. on Tuesday, December 13th, 1927, the PRESIDENT (Mr. D. R. Wilson) in the chair.

The minutes of the last meeting having been taken as read, the HON. SECRETARY read out the names of the following applicants for membership:—

Cooper, J. L. H. .....Electrical Engineer, E.L.M.A. Lighting Service Bureau, Avalon, Jockey Road, Wylde Green, near Birmingham.

Francis, E. .....Wholesale Fittings Co. Ltd., 23, Commercial Street, London, E.1.

Macintyre, J. A. .....Engineer, H.M. Office of Works.

Dudding, B. P. .....Research Laboratories, General Electric Co. Ltd., Wembley, London, N.W.

The names of applicants presented at the last meeting were also read out again, and these gentlemen were formally declared members of the Society.*

The PRESIDENT then called upon Mr. J. L. H. Cooper to read his paper, entitled "An Investigation of Electric Lighting in the Engineering Industry," which was illustrated by numerous lantern slides, and was heard with great interest by those present.

An Investigation of Electric Lighting in the Engineering Industry

By J. L. H. COOPER, B.A., A.M.I.Mech.E., A.M.I.E.E.
(*E.L.M.A. Lighting Service Bureau*).

Introduction.—The modern trend towards standardization in industry has resulted in attaining a degree of workshop efficiency not hitherto available, and it is now realized that the prosperity of all industrial establishments depends to a large extent on the adoption of standardized systems of lighting in workshops, and, in contrast to the earlier lighting systems much more attention is now given to illumination and the arrangements of lighting units.

During recent years a considerable amount of data has been collected and circulated in favour of good industrial illumination, and carefully conducted tests clearly indicate the necessity of installing a modern lighting system in order to attain the high standard of workshop efficiency so vital to industrial prosperity.

In view, therefore, of the important position occupied by lighting in the industrial field and of the extensive publicity given to the subject, it is interesting to ascertain to what extent modern methods of illumination are employed and if the recommendations are suitable for practical requirements, and, in general, to determine if the claims put forward for good lighting are justifiable in actual practice.

The author, on behalf of the Lighting Service Bureau of the Electric Lamp Manufacturers' Association, carried out an investigation covering a period of some months in a large industrial area with the object of collecting practical data and making suggestions which it is hoped will assist in furthering the interests of industrial illumination. The object of this paper is therefore to deal with the practical aspects of a section of the industry embracing machine, erecting, assembly and similar workshops.

The various workshops under review have not been specifically selected on account of having good or poor lighting systems; neither have they been derived from any one particular town or locality. In order to make the investigation representative of the metal trades, observations were carried out in large works and small works owned by companies, individuals, railways, collieries and corporations, and, owing to the variety of different industries involved, may therefore be taken as representative of lighting conditions generally in this section of the engineering industry. Interviews were sought with managing directors, works managers and engineers, whose attitude and opinions were recorded, and these it is thought will prove valuable in many directions.

Many workshops were visited on several occasions, while readings and observations were made under both daylight and electric light with the object of comparing working conditions under each, and in a few instances photographs were taken of workshops where the intensity of illumination, natural and electric, was practically identical.

General Attitude of Employers to Lighting.—The investigation was carried out during the summer months, and, although employers are not as a rule interested to any great extent in lighting at this period of the year, every facility was given to the author in making the survey as complete as possible.

In the majority of cases, directors, works managers and engineers were present when readings were made in their works during the daytime and at night, while the considerable interest shown in these tests indicates that good artificial lighting is considered by employers to be much more than a mere convenience.

In both large and small engineering works the attitude towards the adoption of better lighting is, generally speaking, good. The remark, "we believe in providing our men with plenty of light," was quite a common expression made by employers, but unfortunately, on investigation, this remark did not always indicate that a modern system of lighting had been installed.

The "plenty of light" referred to was often the result of substituting modern lamps for an older type and the retention of the old type of shade and positions

* *The Illuminating Engineer*, December, 1927, p. 337.

of light sources. The majority of employers agreed that insufficient light is a great handicap to the worker. The men much prefer to work in a well-lighted shop, and the tendency on the part of the employers is to meet the wishes of the workmen on lighting matters. On the whole, the larger the firm the better is the attitude towards good illumination, since more attention is given to obtaining a high standard of all-round efficiency and a greater desire to study more closely industrial economics; whereas, in the case of the smaller firm, the lighting problem has not been given any serious attention. The small employers have, in their opinion, improved their lighting system from information obtained in a casual manner or upon the advice given by someone who is aware of the firm's attitude towards expenditure.

In spite of the abnormal conditions existing in some trades where no overtime has been worked for a long time, and although the period of electric lighting is now shorter, due to the introduction of the 47-hour week, only one employer considered it unnecessary to improve the lighting system in accordance with modern practice.

Where possible the opinion of the general manager in the case of a large concern and of a director in the case of a small firm was sought on the importance attached to artificial lighting. The following indicates that approximately 80 per cent. of the people interviewed consider artificial lighting as being important.

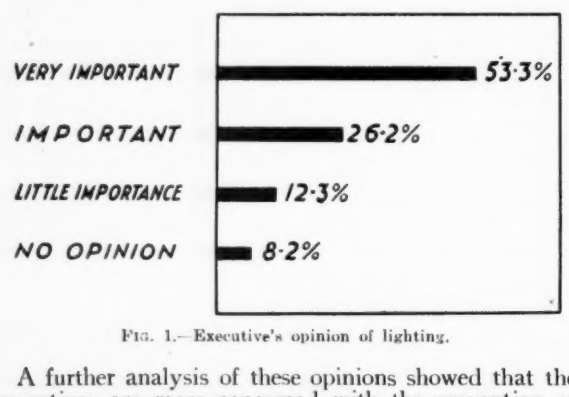


FIG. 1.—Executive's opinion of lighting.

A further analysis of these opinions showed that the executives are more concerned with the prevention of accidents and the improvement of hygienic conditions than increased output. The consideration which appears to be uppermost in the minds of employers is the use of more light to improve the shop appearance to the benefit of employers.

Prevention of accidents in workshops is receiving very close attention at the present time, and everything possible is being done to reduce these to a minimum.

In addition to the adoption of modern lighting systems by the larger firms, it was observed that some were painting machines, sides and legs of benches, with light-grey paint of fairly high reflecting factor (40 per cent.), and this practice is being considered by others.

Employers were very reluctant to give figures of any increase in production due to the adoption of a better method of lighting, although one works manager stated that the output of his machine shops had increased some 15 per cent. as the direct result of changing from a local lighting system to a general system of higher intensity.

It was the general opinion, however, that good lighting is essential to production, and this was not only the opinion maintained by those who had adopted modern lighting systems, but was the opinion of those who *thought* they had a modern system of lighting.

The reasons for lack of further information on this important aspect of artificial lighting may be attributed to three causes:—

(*a*) The relationship between artficial lighting and output has not been sufficiently understood or investigated.

(*b*) The abnormal trading conditions during the past few years, particularly in the smaller trades, have diverted the attention of employers to other directions.

(*c*) Credit for any increase in production which may be partly due to the adoption of better lighting has been assigned wholly to other improved methods of working.

Great satisfaction was expressed by both management and workers in large and small factories where modern systems of lighting were installed, which is indicative of the influence of artficial lighting on workshop efficiency.

Where Lighting is More Progressive.—Generally speaking, it was observed that large engineering, manufacturing and similar concerns have adopted modern illumination systems in practically all workshops. This is not only applicable to firms with buildings of modern construction, but applies equally to firms with buildings of old design. The works engineer follows the trend of modern workshop improvement very closely and has recognized the value of modern artificial illumination. Competition demands up-to-date machinery and working methods to speed up production, complaints from workers are closely studied and poor artificial lighting is not allowed to hinder progress.

Competent electrical engineers or electricians (according to the size of the works) are employed by such firms and are, or should be, acquainted with modern electrical practice.

In the majority of the larger workshops surveyed it was found that standards of illumination, methods of measuring intensity, the value of correct spacing, the use of correct equipment and reflecting factors were readily understood.

It was observed, however, that the different forms of "glare" do not appear to be appreciated, judging by the types of local lights employed in the shops to increase the intensity on a particular working area or for large machine work in conjunction with the general lighting system.

In workshops of the competitive class the lighting problem appears to receive more attention than in the shops of the non-competitive class. In the former the standards of illumination approximated very closely to those recommended and a maintenance system was in force, while in the latter, although an overhead system of lighting had been installed, the standards of illumination were below the recommended values and no regular maintenance system had been adopted.

Average Hours of Artificial Light.—In view of the abnormal conditions which have prevailed in the engineering industry during recent years very little overtime has been worked. Large engineering workshops, such as railways, have intermittent periods of overtime, and it is not, therefore, possible to ascertain with any accuracy to what extent electric lighting is required during the year.

The number of hours during which artificial light is employed varies according to the design of the factory, its size, its locality, and the nature of the work. An assembly shop of the old design, with no rooflights and depending on natural light from side windows, would require the use of artificial light earlier in the day than a modern building with rooflights and side windows. On the other hand, a medium-sized machine shop of modern construction with overhead-driven shafting would require the use of artificial light for about the same period of the day as the first example. The proximity of adjoining buildings and the colour of the interior walls and conditions of the windows are other factors which must be taken into consideration.

In the large engineering workshops with high rooflights and clean walls, the general lighting up period may be one hour later in the day than that of the medium sized works of single-storey construction.

Table 1 shows the average hours of use of artificial light for a number of different processes as given by some 16 firms representative of the various trades.

The average number of hours of electric lighting, under ordinary conditions, is approximately $2\frac{3}{4}$ per day, which amounts to 234 hours per annum, or approximately 10 per cent. of 2,430, the total available working hours per annum, taking a 47-hour standard week.

TABLE I.—AVERAGE HOURS OF ARTIFICIAL LIGHTING.

Firm	Avge. Hours per day	Lighting Period months	Condition of Walls	Rooflights and Windows	Condition of Windows	Kind of Work
A	3	4	Fairly Clean	Rooflights	—	Stamping
B	2½	3½	Dirty	Rooflights	—	Toolmaking
C	2½	4	Clean	Both	Dirty	Assembling (rough)
D	2½	4	Clean	Rooflights	—	Machining
E	3½	4	Dirty	Windows	Dirty	Assembling
F	2½	4	Clean	Rooflight Windows one end	Fairly Clean	Assembling (medium)
G	2½	4	Clean	Rooflights	—	Stamping
H	3	4	Fairly Clean	Both	—	Machining (fine)
I	2	4	Clean	Rooflights	—	Erecting (large)
J	3	4	Clean	Rooflights Windows one side	Fairly Clean	Repair (large)
K	2	4	Clean	Both	Clean	Repair (small)
L	3½	4	No effect	Part of Rooflights Windows one side	Dirty	Machining (medium)
M	3	4	Fairly Clean	Windows one side	Dirty	Toolmaking (small)
N	2½	4	Clean	Rooflight	—	Machining (heavy)
O	3	4	Clean	Rooflight	—	Engraving
P	3	4	Clean	Windows	Fairly Clean	Fine Sorting

If allowances are made for dull afternoons which are experienced during some of the winter months and foggy periods, this period of 234 hours would be considerably increased. Another factor which tends to increase the period of artificial illumination is the practice of colour washing rooflights of some engineering works in the summer months, and although the greater portion of the material may have worn off, say before October, part still adhered to the glass for quite a considerable period due to slackness in cleaning the rooflights at the beginning of the artificial lighting season.

The average hours per day as shown in table represents the period when the whole of the lighting would be required and does not include individual bench or machine lights, which would be necessary in some cases long before the general lighting.

The colour conditions of the walls indicate that these in many cases, particularly in the older type of workshop, are whitened in the early spring, whereas colour washing in the early autumn would materially assist artificial illumination during the winter months.

As one would anticipate, "fine processes," such as fine sorting and engraving, require the use of artificial lighting earlier in the day. This is quite apparent in Table I.

The Amount of Daylight in Workshops.—Daylight intensities varied from 45 foot-candles to 10 foot-candles, representing the maximum and minimum values respectively. The higher figure was obtained in a large erecting shop, while the lower figure was obtained in a small machine tool shop. The amount of daylight for both large and small workshops averaged 20.5 foot-candles. The results may be summarized as follows:

Works with average amount of daylight 46.6 per cent.
Works with more than average daylight 16.8 per cent.
Works with less than average daylight 36.6 per cent.

Requirements of Good Illumination.—Any system employed, which, of course, will be designed according to the nature of the work involved and the characteristics of the building, must fulfil the following principal conditions:

1. Adequate illumination on the working surface and surroundings.
2. Freedom from heavy shadows.
3. Freedom from direct and indirect glare.
4. Light from proper directions.

Illumination Intensities.—The intensities of illumination which have been prepared and issued by the Lighting Service Bureau were used by the author in this investigation, as a basis of comparison.

In application of these recommended foot-candle intensities it should be borne in mind that they refer to the illumination to be measured on the actual working surface, which may be horizontal, vertical or inclined.

The illumination intensities given are those recommended for average working conditions, that is, they are not the illumination values obtained when the lamp and equipment are new and clean.

Modern Systems of Lighting.—There are three principal systems of lighting which find application in the metal-working industries, namely:

(*a*) General lighting.
(*b*) Localized general lighting.
(*c*) Combined general and local lighting.

and these may be briefly described as follows:

(*a*) Light units mounted overhead on a symmetrically arranged layout to produce approximate uniform illumination throughout a definite area.

(*b*) Light units mounted overhead, but located with respect to benches or machines.

(*c*) General illumination system supplemented by local lighting units mounted close to the work so that the local illumination is concentrated over a definite area and provides no general light.

General Lighting Conditions of Engineering Works Investigated.—In assessing the lighting conditions of the various works, the principles of modern systems, the requirements of good lighting which have been outlined, and present-day values of illumination were considered in conjunction with practical requirements.

These conditions are shown in the following diagram:—

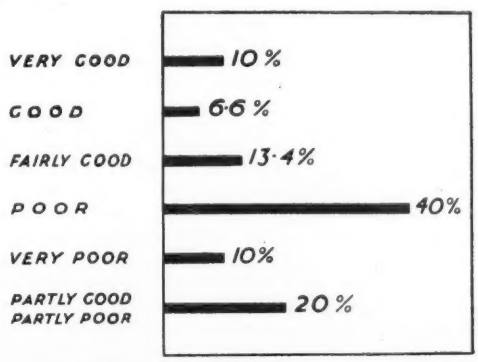


FIG. 2.—Lighting conditions in works investigated.

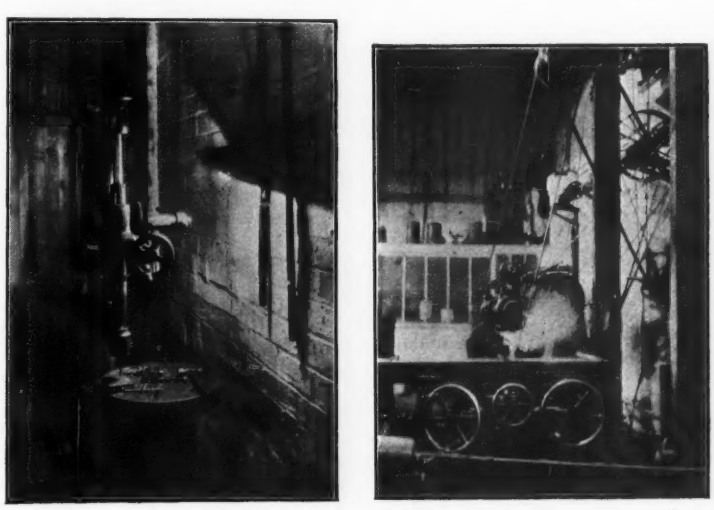


FIG. 3.—Examples of glare from local light sources.

In the grades "good" and "fairly good" it was observed that in most instances greater attention had been given to the design and maintenance of the lighting system, but that where local lighting was employed it suffered in these respects. The lamps of local units were often inadequately shaded and gave rise to glare, and in one large works carbon lamps were installed to satisfy the men who had complained of glare.

A similar experience was met in another machine shop, using a local lighting system; gasfilled lamps were not installed, the reason stated being "too much glare." Glare, when using shallow shades instead of deep reflectors, was inevitable.

In a further shop bare lamps were used because "We want all the light we can get," while in yet another instance the reason given for the absence of reflectors was that "the white wall reflected the light." It is obvious from these observations that the purpose of the modern reflector is not properly understood.

The grade "partly good—partly poor" indicates that a gradual change-over is in progress from an old to a modern system, and, in some cases, it would appear that the progress of the change-over will depend upon improved trading conditions to a very large extent.

The adoption of a modified form of a local lighting system for general purposes is the cause of much poor lighting, and the extent to which this system is employed is shown in Fig. 4, under the heading "Conical Shades and Clear Gasfilled Lamps." Although the evil effects of glare were acknowledged in many instances, no attempt has been made to eliminate this objectionable feature.

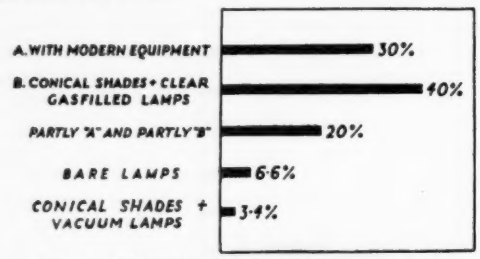


FIG. 4.—Incidence of lighting equipment in works.

The high percentage of conical shades with gasfilled lamps is largely due to the practice of replacing a broken or burnt-out vacuum lamp with a gasfilled lamp, and the retention of the same type of shade. Even in a works of modern construction, with up-to-date machinery and progressive management, the lighting system consisted of hundreds of 100-watt clear gasfilled lamps in 10-inch enamelled-iron shades, regularly cleaned, and considered by those responsible for the installation as being a very good system.

Responsibility for Lighting Scheme.—As already indicated, installation in the larger works is carried out by the works staff, but practically all such work in the smaller workshops is carried out by local contractors, who are instructed by the works manager, after consultation with the foreman or charge hand, as to lighting positions. The lighting installed is often contrary to modern practice, but in accordance with individual ideas.

Of all the works reviewed, installations were carried out as follows:—

Outside contractors carried out 53.4 per cent. of lighting.

Works electricians carried out 46.6 per cent. of lighting.

Cleaning of Lamps and Equipment.—Another important feature of the investigation was to ascertain whether a maintenance system was in force, and, in addition, to record the methods employed. At the time the survey was made 20 per cent. of works had clean equipment, 36.6 per cent. had fairly clean equipment, and 43.4 per cent. had dirty equipment.

On subsequent visits to these works, as a result of calling attention to the matter, it was observed that, in many instances the equipment had been cleaned. Often the cleaning of reflectors was ineffective, due to deterioration of the reflecting surface.

The following table gives the results obtained from visits to three works:

TABLE II.

Works	Visits	Maximum Horizontal Illumination F.C.	Percentage increase in illumination after cleaning	Condition of lamps and equipment
1	1st 2nd	4·5 6·0	— 33·3	Dirty Clean
2	1st 2nd	7·5 9·0	— 20·0	Dirty Clean and few new lamps
3	1st 2nd	9·5 10·0	— 11·0	Fairly clean Clean

The periods of cleaning and methods adopted were found to vary considerably, and in the majority of the works no record was kept by the management of the number of lamps used or when they were cleaned. Some 16 per cent. of the works visited had from time to time kept partial records, but these had not been kept up-to-date.

The general appearance of the shops, however, indicated whether the management paid any or little attention to the keeping of the lighting equipment clean. The following table gives some further information on this subject.

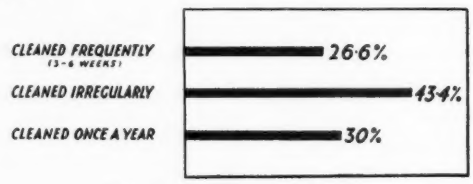


FIG. 5.—Frequency of cleaning.

The following represent systems for maintenance and cleaning which were found in practice:

1.—(*a*) The foreman of each shop was responsible for the cleaning of the equipment.

(*b*) An organized cleaning staff.

Both methods can be recommended, as the cleaning is done under proper supervision.

2.—Cleaning is carried out by the individual workman or handy man without proper supervision. This involves loss of valuable time on the part of the workman, greater lamp casualties, and the cleaning lacks thoroughness.

3.—General cleaning taken at the beginning of the lighting season. This method prevails in large engineering shops with high roofs, and cleaning is carried out under proper supervision. Many smaller works also only clean units once a year. The cleaning of the lighting equipment between visits, as shown in table, achieved a useful purpose in demonstrating to the employer the importance of regular cleaning, since it was possible to compare the difference in the illumination obtained.

Types of Lamps Employed.—It is now common practice to replace burnt-out or broken lamps of the older type by gasfilled lamps, but where lamps are being frequently broken, due either to vibration or rough usage, the vacuum lamp is employed in preference to the gasfilled.

The accompanying diagram shows the types of lamps used in works, and it is interesting to note the extent to which the gasfilled lamp predominates.

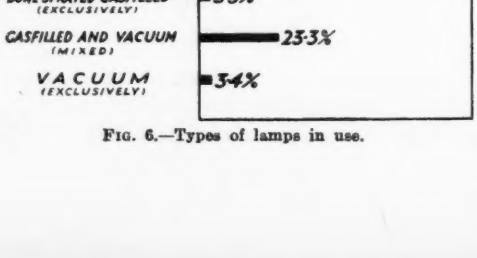


FIG. 6.—Types of lamps in use.

Every employer and works manager is quite familiar with clear gasfilled lamps, but few are familiar with the advantages of the opal, white-sprayed or internal-frosted lamps, and are under the impression that a considerable amount of light is lost through absorption of the obscuring material.

Daylight Lamps.—In contrast with the many applications to which the daylight lamp has been applied in other industries for colour-grading purposes, little or no use is being made of this type of lamp in the engineering industry. Many of the employers interviewed remarked on the difficulty of sorting, inspecting and grading different coloured alloys under artificial light, and in particular by the difficulty of handling small polished articles. One large manufacturer stated that great inconvenience was caused to his buyers or customers who called at his works, between 3-30 p.m. and 5-30 p.m. in the winter months, to select furniture fittings and being forced to revisit the works the following morning because the fittings could not be selected under artificial light. These fittings appeared darker under ordinary electric lamps than under natural light. This is an instance where the application of the daylight lamp, or unit, could be employed with advantage.

Daylight lamps could also be employed to advantage in plating shops, on "marking off" tables and in efficiency departments, and similar operations. While no general use is being made of daylight lamps at present in the engineering industry, it is, however, interesting to note that in such instances where these lamps were employed both management and workers have found this application of the daylight lamp very helpful.

Indirect Glare in Workshops.—Reference has already been made to the presence of direct glare in workshops, but many instances were found of indirect glare due to specular reflection from metal-covered benches and highly polished articles, this being particularly noticeable where clear gasfilled lamps were employed.

In one works a high intensity of illumination is necessary for sorting and inspecting small bright steel articles. The illumination was provided by 200-watt clear gasfilled lamps in dispersive reflectors spaced 7 feet apart and mounted 6 feet above the bench. The average intensity was about 12 foot-candles.

The workers found reflected glare very trying and many complained of headaches and dizziness. The trouble was eliminated by using bowl-sprayed lamps in one-half of the shop, while in the other part, for further experiment, industrial enclosing units were employed.

Types of Buildings.—Workshop buildings may, generally speaking, be divided into two groups, namely:

1. Those having high roofs, say 65 feet and relatively long in comparison with their width, with an overhead travelling crane. Examples: Erecting, heavy machine tool shops.
2. Those with roofs up to 30 feet, of which machine, assembly, and power press shops are examples.

In the first case, the lighting units must be suspended above the crane track, or mounted on the supporting columns below the crane. Where, however, illumination on vertical surfaces is just as important as that on horizontal surfaces, both overhead and side methods of lighting are essential.

In the second case, although the mounting height is lower and shafting, etc., likely to cause shadows, either a general or localized system of lighting can be employed. The lighting of a workshop with a roof height of some 65 feet must necessarily require special attention, and while general lighting appears to be adequate for the work of a general erecting shop, local light units are necessary in addition for a machine shop of this type.

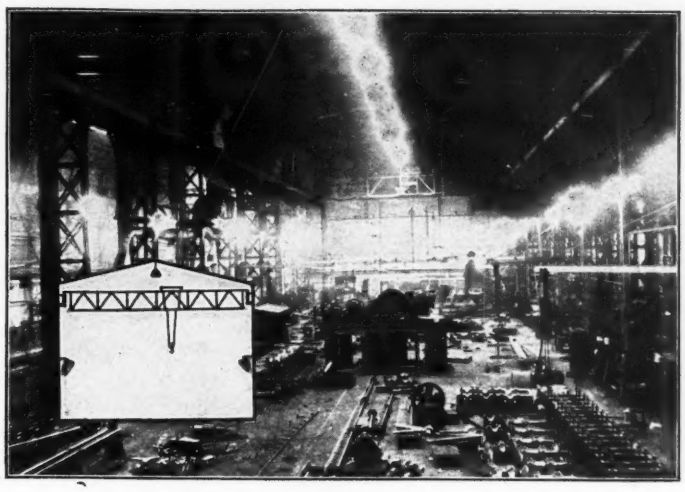


FIG. 7.

Erecting Shops.—There were not many opportunities of inspecting large erecting shops; those, however, which were investigated indicated that modern methods of electric lighting were employed.

Reference may be made to one particularly large shop with a roof height of some 65 feet, where the general lighting consisted of large units (1,000 watts) arranged centrally throughout the length of the shop, and mounted 60 feet from the floor. A supplementary system was provided by mounting special angle units (500 watts) on the supporting columns on each side of the building. The average illumination, measured 3 feet from the floor, was 8 foot-candles.

Although the general illumination was good, it was, however, observed that glare from the side units was particularly objectionable from certain positions. If white opal, white-sprayed or bowl-sprayed lamps had been used instead of clear, glare would have been eliminated, while the loss of illumination due to obscuration would have been negligible.

A night photograph of this particular shop is shown, and experience indicates that height does not preclude good lighting.

Although a high mounting height necessarily reduces the percentage of light flux from the lamp that reaches the working plane, this is compensated in a large measure by the use of high wattage gasfilled lamps with their greater luminous efficiency.

Large Machine Shops.—The lighting conditions of large machine shops are similar in many respects to those of erecting shops, that is, the units must be mounted above the crane track for general illumination, and, in addition, local light units are essential for certain processes.

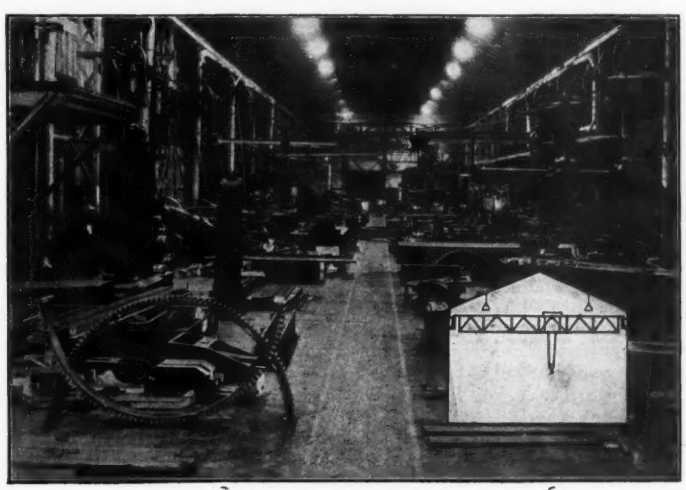


FIG. 8.—Large machine shop.

Two methods of electric lighting were found in practice, each consisting of a general system and local units.

In the first case two or more rows of large units are employed, which give an average high intensity of general illumination. In the second case several rows of smaller units are used, which give a lower intensity of general illumination, but this is supplemented by using angle units, which not only increase the general illumination available but provide more vertical illumination.

Although modern methods of electric lighting appear to be generally adopted in large machine shops, it was also observed that in some instances the values of illumination were above the recommended working values, while in other instances the values of illumination were below present-day recommended values.

Taking the recommended values for lighting published by the Lighting Service Bureau, it will be interesting to compare the lighting values in a number of large shops, and for this purpose Table III has been compiled.

It will be observed from this table that all the firms employed an overhead system of lighting, with a variation in mounting and spacing heights of units and a corresponding variation in lighting values. Firm "B" is now installing angle units to supplement the general lighting, and to obtain more vertical illumination. Firm "D" has bare lamps on each side of the shop, and the illumination is very inadequate, and it was observed that a large number of local units were necessary.

Lighting Machine Tools.—There are some processes, such as vertical boring, internal machining, planing, fine machine work, gear cutting and similar work, which require local lighting. With such exceptions machine tool work can be carried on with good lighting from overhead units. This was particularly noticeable in those shops where the average horizontal illumination was 8-9 foot-candles, whereas in the shops where the general lighting was below the recommended values a local light unit was invariably provided and used at every machine.

Generally speaking, even with uniform general lighting the workmen will from force of habit, in some cases, use a local light to set up their machines, thinking they cannot see or work properly unless there is a lamp directly over the tool.

In several works a uniform system of electric lighting is employed and all local light units dispensed with for machine work (except for certain specific processes), and the workmen in particular are enthusiastic in their praise of the new system.

The elimination or at least a considerable reduction in the number of local lights units in a machine shop could be achieved by raising the standard of general illumination, thus reducing an expensive workshop item and eliminating the risk of glare which is usually found with local units.

TABLE III.

Nature of Work	No. of Rows	Size of Units watts	Mounting Height ft.	Spacing of Units ft.	Distance between Rows ft.	Average Horizontal Illumination F.C.	Recommended Intensities F.C.
A. Rough	2	500	32	22·5	30	8	6
B. Medium	3	200	30	20·0	20	4	10
C. Medium	2	500	25	25·0	20	9	10
D. Rough	2	300	12	30·0	—	3	6
E. Medium	2	300	20	20·0	staggered	6	10

Another interesting feature in support of the foregoing remarks was the comparatively small size of local light units employed in shops where the general lighting intensity was in the region of 8 foot-candles.

Table IV gives the tool point intensities of five machine shops.

It will be observed from Table IV that shops of firms "A" and "D," where the horizontal illumination was 8 and 9 foot-candles, employ comparatively small local lights, whereas, in the shops of firms "B," "C" and "E," the local lights were larger.

The following particulars are of a similar character but apply specifically to a gear-cutting shop.

TABLE V.—GENERAL AND TOOL POINT INTENSITIES (GEAR-CUTTING SHOP).

Daylight				Electric Light				
Average Intensity of Daylight F.C.	Tool Point Intensities H. F.C.	Tool Point Intensities V. F.C.	Ratio H/V	Average Intensity Night F.C.	Tool Point Intensity H. F.C.	Tool Point Intensity V. F.C.	Ratio H/V	Local Unit
30	20	10	—	7·5	5·0	2·0	—	Without
—	—	—	—	—	12·5	5·5	—	With
—	25	10	—	7·5	4·5	2·5	—	Without
—	—	—	—	—	14·0	7·0	—	With

In measuring tool point intensities at night, the readings were taken with the local unit in its usual working position.

Small Machine Shops.—Very little progress appears to have been made in the lighting of small shops, and the tendency to retain some form of local lighting is still very prevalent in both old and new works. On the other hand, many improvements were observed in workshop methods: new machinery had been installed, new ideas of working had been introduced; but the only change observable in electric lighting methods in the majority of the machine shops was the substitution of a modern high-efficiency lamp and a slight modification in the mounting of the units. Although the gloomy conditions which previously existed with the older type of lamp had been dispelled, patchy illumination and dense shadows still remain, and a new and dangerous feature had been introduced, namely, direct glare. The intensity of the average illumination had been increased, but the gain in this direction is entirely negatived by the presence of glare from every unit.

Many of the executives are of the opinion that a system of overhead lighting is unsuitable for small shops, since the arrangement of the shafting and belting precludes such a system.

These opinions would clearly indicate that modern electric lighting systems are not understood. In the majority of the shops a re-arrangement of the lighting units with modern equipment would result in much better illumination and, in many cases, a reduction in the number of existing lighting units.

TABLE IV.—COMPARISON OF GENERAL AND TOOL POINT INTENSITIES OF SIMILAR MACHINES IN WORKSHOPS.

Daylight				Electric Lighting			
Shop	Average Intensity Horizontal F.C.	Tool Point Intensity Hor. F.C.	Tool Point Intensity Vert. F.C.	Average General Electric Lighting Horizontal F.C.	Tool Point Intensity Hor. F.C.	Tool Point Intensity Vert. F.C.	Type of Local Units
A	25	10	6	8	12	5·5	32 c.p. carbon lamp flat reflector
B	18	14	10	4	20	10·5	60-W. vacuum lamp concentrating reflector
C	16 Dull day	12	9	3	18	8·5	60-W. vacuum lamp white paper shade
D	22	18	10	9	12	6	40-W. vacuum lamp concentrating reflector (Aluminium reflector surface very dull)
E	25	20	14	5·5	20	15	100-W.G.F. lamp in deep concentrating reflector

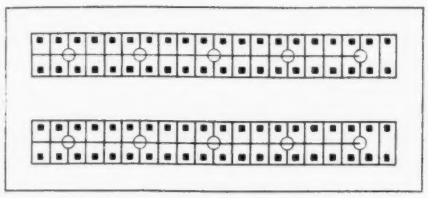


FIG. 13.—Arrangement of Lighting for Kick Press Benches.
O Lighting points. • Kick presses.

Of all the small machine shops investigated, 20 per cent. employed modern methods of electric lighting, while 80 per cent. of the shops had equipment of obsolete type giving unsatisfactory lighting. In those shops where modern systems were employed, namely, uniform general or localized general lighting, it was observed that the former was preferable. In the latter case it was common to find the units located with respect to machines at a less height than those giving purely general lighting. The tool point intensities were found to be fairly high, but some glare was inevitable, due to the low mounting, while the general illumination was found somewhat uneven, varying from 7-4 foot-candles. The provision of general illumination of high intensity, uniform in character, appears to be pre-eminently suitable for the average small workshop, and, in general, localized units are unnecessary, besides the fact that such an arrangement restricts subsequent modifications of the shop layout.

Many are under the impression that general overhead lighting uniform in character does not lend itself to the requirements of power and hand-press shops and that local lighting was necessary. The author, however, found that general lighting of 10 foot-candles provided excellent illumination, as the illustration shows, and the use of local units can be entirely avoided.

The following table gives tool point intensities in some of the shops investigated:

FIG. 9.—Small Machine Shop Lighting. Incorrect method, giving inadequate illumination—heavy shadows and glare.

It will be observed from the table that where the general lighting intensities are lower than those recommended, shops are using antiquated equipment or local lighting, but it must also be remembered when considering this table that shops employing modern methods of lighting amount to only 20 per cent. of the total.

It was also observed that almost all the good lighting installations employed equipment similar to that specified in the British Engineering Standards Specification No. 232 for Industrial Reflector Fittings (Open Dispersive Type) and that generally an illumination of 10 foot-candles was obtained when these units were spaced on about 10 foot centres and fitted with 200-watt gasfilled lamps. This corresponds to 2 watts per square foot of shop, and it is interesting here to note that a survey made by my association last year in factories, chiefly engaged on small work, showed that an average of only 0.61 watts per square foot was available, and this, under favourable conditions, would provide only 3.0 foot-candles illumination.

In view of the fact that much of this work is "fine" in character there would be justification for using higher values of illumination that at present exist. The Illumination Research Technical Paper No. 3 of the Department of Scientific and Industrial Research clearly shows that illumination intensities up to at least 20 foot-candles may be economically justified.

Local Lighting in Small Machine Shops. — Adequate lighting in small machine shops can usually be provided entirely from an overhead system, but occasionally there are special instances where the general lighting must be supplemented by local units. Some of these have already been enumerated while discussing the use of local lighting in large machine shops, since similar conditions exist in small machine shops. As a general rule, local lighting is invariably employed in addition to first-class general lighting on very fine processes, such as fine milling, fine assembly, engraving, etc. This latter application is particularly interesting. In one installation each workman was provided with a local unit, so that it could be adjusted to any position

TABLE VI.—GENERAL AND TOOL POINT INTENSITIES IN SMALL SHOPS.

	Daylight			Electric Light				
Nature of Work	Average General Intensity F.C.	Tool Point Intensities Hor. F.C.	Tool Point Intensities Vert. F.C.	General Intensity Average F.C.	Recommended Intensity F.C.	Tool Point Intensities Hor. F.C.	Tool Point Intensities Vert. F.C.	Remarks
A. Medium	18	12	5	10	10	7	3	General overhead system, 100-W. lamps. Modern equipment, units lower over machine
B. Medium	20	10	7	10	10	7	4	System as above, 200-W. lamps, illumination uniform in character
C. Medium	15	12	8	10	10	8	4	Ditto.
D. Medium	15	15	12	7	10	10 5	4 2·5	General overhead system, modern equipment, units spaced too far apart
E. Medium	12	10	7	3·5	10	7 5 3 1	3 3 1 —	Old equipment, irregular spacing, different sizes of gasfilled lamps
F. Medium	16	16	8	6	10	4·5 2	2 0·8	Partly old and partly modern equipment
G. Medium	20	18	7·5	3	6/10	3 2	1 0·5	Local system, units irregularly spaced, old equipment, different types of lamps
H. Rough Grinding	12	8	5·5	4	10	9	3	Local system, modern lamp and old equipment per spindle
I. Rough	18	16	10	4	6	8	3·5	Local system, old equipment, different sizes of lamps
J. Medium	18	8	6	6	10	4 2	1 —	Local system, bare lamps

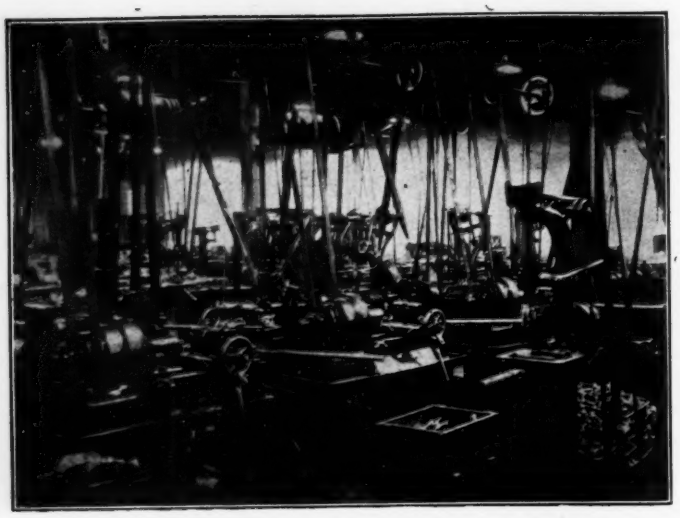


FIG. 10.—Small Machine Shop. Well lighted; uniform intensity.

FIG. 11.—Poor Lighting for Power Presses.

FIG. 12.—Well-lighted Power Presses.

and permit adjustment of the direction of the local light provided, while it is still more interesting to note that the combined effect of general and local lighting gave a higher intensity of illumination than was available during daytime.

The following readings were obtained in this particular shop: Daylight intensities on horizontal, 15 foot-candles; on vertical, 12 foot-candles.

Electric lighting, horizontal at 30 foot-candles; on vertical, 24 foot-candles, tool point.

The general illumination provided was 10 foot-candles.

The following photographs give an indication of the nature of the work and the lighting provided.

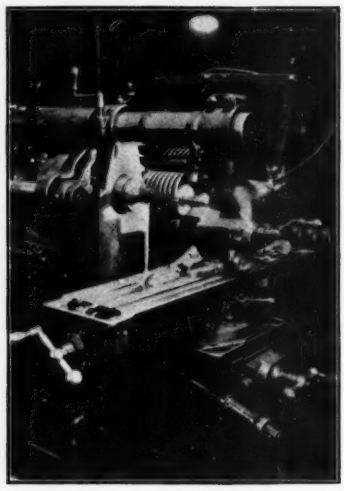


FIG. 14.—Excellent local lighting for fine milling.

Types of Local Units.—It has already been pointed out that in many instances little or no attempt is made in the case of local units to screen the light source. The usual shallow type of conical reflector is totally inadequate, and yet was found to prevail in the majority of

FIG. 15.—Bracket light for die-making and engraving.

instances. Two types of local units were found to give satisfactory service when provided with deep reflectors which entirely screen the lamp:—

1. Floor standards, usually adjustable with heavy iron base and frequently employed in heavy machine shops with 60–100 watt gasfilled lamps.

2. Adjustable brackets which may be attached to wall, bench or machine.

Cost of Lighting.—It was not generally appreciated that the cost of lighting in the average workshop represents a very small percentage of other charges, when one considers the pay roll or capital charges. In general, the cost of good lighting both in large and small workshops does not exceed 0.86 per cent. of the wages bill. The cost, therefore, of good lighting cannot be considered as a burden on industry, but on the contrary is economically sound, giving improved works efficiency.

General.—The survey has amply shown that increased interest is being taken in the subject of lighting by factory executives, but that in the majority of instances the underlying principles of good lighting are insufficiently understood. Much educational work is still necessary in order to avoid glare and yet provide sufficient light.

It appears necessary to provide the industry with concrete recommendations and diagrams indicating how modern lighting should be installed. One or two interesting facts emerge from the survey. The first is the almost general use of the gasfilled lamps and the fact that the standard of lighting at night is in the best examples equivalent to 50 per cent. of that obtained during daytime and, moreover, that there is a tendency to install electric lighting of still higher intensities. A further important point is the fact that the ratio between the illumination provided at tool point to that generally provided in the shop is about 2 : 3, while the ratio of horizontal to vertical illumination at tool point varies between 2 and 3. In each instance these ratios are comparable with those obtained under daylight conditions.

As a result of this work, it is hoped to publish elsewhere a handbook giving some specific recommendations on the arrangements of lighting units for different types of shops investigated.

In conclusion I should like to express my thanks and appreciation to the many works executives who so readily gave facilities to enable this work to be carried out.

Discussion

The CHAIRMAN stated that the meeting had the advantage of the presence of Mr. Werner (His Majesty's Superintending Inspector in the Midland Division), in which part of England, he gathered, most of Mr. Cooper's observations had been made. He was sure that members would like him to invite Mr. Werner to open the discussion. (Applause.)

Mr. E. A. R. WERNER said that it was a great privilege to be called upon, and to have the first chance of congratulating Mr. Cooper for his most excellent paper. He thought that all would feel that it contained a great amount of food for thought. Speaking with knowledge of the Midland area, he wholeheartedly agreed that much more interest was being taken than in the past in the question of lighting. There was a better realization of the importance of efficient lighting, but there was still need for instructed propaganda work.

The lecturer had referred to the difficulty of getting figures to show the effect on output of improved lighting. It was almost impossible to get reliable figures because, quite naturally, the firms who took the lighting problem seriously were also firms that were progressive in other ways, such as the arrangement of the machinery, and so on.

Once a firm had decided to tackle seriously the lighting problem in, say, a small machine shop, it was usually recognized that it was necessary to provide for both general and localized illumination. If the general illumination was properly planned first, as the speaker thought Mr. Cooper would prefer, it would doubtless be found that ample illumination was secured at many of the machines, but there would almost inevitably be some machines at which individual lights would be required. In the Midlands (at any rate until recently) there had been a marked preference for approaching the problem from the opposite end, i.e., a localized light had first been provided for each machine, and then supplementary general lights added where necessary to illuminate gangways and to dispel the general gloom occasioned by localized lighting.

It would be interesting to have data which would enable comparisons to be made between installations of combined general and local lighting and those where the lighting is of the type described by Mr. Cooper as "localized general lighting." In connection with this latter type serious lighting errors had arisen, one of which was illustrated by the following case:—

The lighting installation consisted of a 100-watt gasfilled lamp over nearly every machine, with no separate lighting for gangways. The lamps were for the most part at heights of between 8 feet and 8 feet 6 inches from the floor, the highest being 9 feet 3 inches, and the position of the lamps was not adjustable either horizontally or vertically, but each lamp was encased in a deep parabolic reflector, so that there was no glare. The lumeter readings with this system were not satisfactory, averaging only about 3 foot-candles at the working point.

Lack of proper maintenance seemed to account for a good deal of the uneven lighting frequently met with. He cited a case where an increase of between 20 and 25 per cent. in illumination resulted merely through wiping the dust off the reflector with a dry cloth. The use of lamps of the same make and size but of varying ages was another cause of uneven lighting.

In connection with general lighting there appeared to be some tendency to overlook the importance of the small shadow. Mr. Cooper had not referred in his paper to the possibility of having the work "flattened out" by a perfectly distributed system of general illumination. If an operator was working on a machine which was exactly midway between equal sources of light, one on the right and one on the left, the small shadow which is so necessary to show up every bit of relief-marking on the work was apt to be obliterated. When Mr. Cooper referred to the fact that workers in a shop with good uniform general lighting often ask for a supplementary local light he attributed this to mere force of habit; but might it not sometimes be due to the real necessity for a little one-sided illumination to throw up fine shadows in the work itself?

With localized lights it seemed desirable to emphasize the importance of provision for adjusting the position of the lamps. It was not always essential to provide for the best illumination at the point where the work was done, since an expert worker could sometimes judge his fine work best by feel, in which case he would shift the lamp to the most convenient position for reading his micrometer accurately.

In conclusion, he wished to express his personal thanks to Mr. Cooper for the very many helpful items in his paper. Many of his (Mr. Werner's) comments had been based on observations of relatively good practice, but there was still so large a proportion of works where the lighting arrangements could be described only as casual that he felt it was difficult to overestimate the value of the propaganda work which was being carried on by the Illuminating Engineering Society.

He was very grateful for the invitation to attend the meeting and for the opportunity to join in the discussion of Mr. Cooper's paper.

Mr. J. ECK thought that the members of the Society had never had a better paper read to them or one which more thoroughly covered the ground with which it was intended to deal. He was sure that they would all look forward to seeing it in *The Illuminating Engineer* and having an opportunity to study it in detail.

They were particularly fortunate in having Mr. Werner with them. His contribution to the discussion was just the type which they desired to have, because he could give first-hand information on the subject, and his views naturally commanded respect. He wished that Mr. Werner could attend all their meetings and get his staff to come on every possible occasion.

With regard to cost, the local contractor often put in the cheapest work. It was the duty of *The Illuminating Engineer* to educate everybody who dealt with lighting.

The psychological side of the question had not been dealt with in the paper. In the days when he was interested in arc lighting he found that staffs on properly lit premises expressed anxiety to keep on working late, the conditions being so good that they were not tired. The question of the effect of proper surroundings on the human element was a very important one.

Another point not mentioned was the liability to minor injuries where the light was not good. Even when claims did not arise from such injuries they slowed down the work. The question was therefore an important one. There were now available simple methods of furnishing workshops with adequate artificial lighting. It should be impressed on owners of shops that the cost of installing proper lighting would not be great, and they should be advised to consult an illuminating engineer.

Each problem required to be studied, as there was no general panacea. There was an enormous field open for educational work. In these busy competitive times concise and helpful recommendations were needed.

Mr. H. D. JACKSON said that he was glad that he had had an opportunity of hearing the lecture. He was not an illuminating engineer, but was one of the manufacturers whose works Mr. Cooper had visited. He had not met anyone who had taken more care and trouble than Mr. Cooper had.

One of the difficulties met with in the past had been that no information could be obtained as to the intensities required and the means of obtaining them. The knowledge of local contractors and of corporations on the subject was very limited. Authorized undertakers did not always make themselves acquainted with the necessities of the manufacturing world so far as lighting was concerned. When, just after the war, he decided to build new works he thought that it would be easy to get information on the question from the corporation selling electricity, but actually he had great difficulty. Fellow-manufacturers and others whom he had consulted had stated that it was impossible to light a power-press shop satisfactorily with overhead lighting. However, the problem had been solved by investigation. The result of continuous experiment showed that 10-ft. centres were necessary.

Mr. Jackson also emphasized the importance of the direction from which light came. A toolmaker working to a line on a blue surface and to very fine limits must have local lighting in a certain direction. As a rule, the workman was looking at his work vertically.

The Illuminating Engineering Society was solving many of the difficulties involved in industrial lighting, and was able to furnish most valuable advice.

As Mr. Werner had said, there were several factors affecting output, and it was important to get data to show which part of the increased output belonged to one cause and which to another. His opinion was that general illumination was satisfactory for ordinary purposes, and that only in specialized work was individual lighting required. At one time die-sinkers were troubled with glare through the brightness of what they were engaged upon. The difficulty was solved by using obscured lamps.

The CHAIRMAN said that he was sure that all present felt grateful to Mr. Jackson for stating the manufacturers' point of view.

Mr. A. W. BEUTTELL said he wished to congratulate Mr. Cooper on his paper. He particularly admired the thoroughness with which the paper had been prepared. A mass of information which was very helpful on the commercial side had been given. The position was that 40 per cent. of the places under consideration were badly lit, and gasfilled lamps in totally unsuitable reflectors were still being used.

He would like, however, to raise one question that had never been properly studied—the distinction between the illumination as recorded by a photometer and what might be termed the subjective illumination or brightness as actually seen by the eye. This latter quantity was obviously affected by various circumstances, but especially by the glare from exposed lights within the range of view. At present, when they sought to explain why one installation was better than another from the standpoint of its effect upon the eye, they were driven to complex explanations. He (Mr. Beuttell) had carried out a number of investigations on this subject by the aid of a special instrument in which the comparative brightness as seen by the eye when completely screened from extraneous light and when subjected to more or less glare could be determined.

He would like the Society to bring this problem before the notice of the Illumination Research Committee operating under the Department of Scientific and Industrial Research.

The CHAIRMAN remarked that the committee dealing with the physiology of vision for the Medical Research Council had in hand fundamental research work on the question of glare. It was an extraordinarily difficult subject to investigate, and it would probably be some time before practical results were available.

Mr. L. E. BUCKELL expressed his appreciation of the paper. He thought that it was a model, and would be really helpful. Mr. Cooper had discriminated in the clearest possible way between the results following good lighting and bad lighting, and he was sure they were all very grateful to him. He would like to know whether Mr. Cooper, during his investigations, had come across complaints of eye trouble and loss of time caused by bad lighting conditions.

Mr. Werner had put the case in a nutshell when he said that the system of lighting adopted must depend on the particular job that was being done. As a general rule what was required in the engineering industry was general lighting. The demand for local lighting was often bound up with the fact that man had grown up with such a system. He recalled the case of a big motor-car factory in the Midlands; the lighting of the shop was designed before a brick was laid and before any machinery was put in the factory. A uniform intensity of 5 foot-candles was adopted, and the system had remained unaltered. He attributed that to the fact that the workmen starting with a good system of general lighting had not any preconceived ideas which made them ask for any other method. In another case, where the first of four separate shops was lit with a uniform intensity of about 5 foot-candles, men said that the lighting was entirely wrong and must be altered. Yet, after a month's trial, instructions were given for the remaining shops to be lit as quickly as possible in the same way.

With regard to colour-correcting lamps, engineering shops afforded one of the biggest fields for the use of such devices, as it was often necessary to discriminate between shades of the same colour near to one another.

It was very satisfactory to hear that standards of illumination had risen. He thought that there was no need to worry over the cost, which was fully justified by the resulting better work. The question of cleaning was an important one. He felt that for factories they must try to produce lighting equipments which did not need so much cleaning as was required at present. He did not see why the equipment should not be made more or less dust-proof. The right way of dealing with any case of unduly frequent breaking of lamps was to find out the cause and try to avoid it. A great deal of the difficulty could be removed by the use of an anti-vibrator. Lamps should, however, be renewed at regular intervals and should not be allowed to burn out.

An improvement in trade was already apparent and illuminating engineers could help the engineering industry to take the fullest advantage of it by their advice on the question of proper illumination.

Mr. G. CAMPBELL said the paper gave the best information that he had met with in regard to lighting factories. He thought that the lighting installations in the engineering industry were better than those met with in other trades, and he attributed this fact to the connection between the electrical industry and the engineering industry.

Mr. A. CUNNINGTON thought that there must be a large number of cases in which both general and local lighting were necessary. The point to be aimed at was the utmost scientific efficiency, even if, in certain cases, it could be shown that the cost was negligible.

Mr. L. WARD (Home Office, Factory Department) remarked that the lecture was very helpful and interesting, and he wished to congratulate Mr. Cooper on placing another milestone on the road to efficient factory lighting. It was necessary from every point of view, and especially from the standpoint of prevention of accidents.

He wished to congratulate the Illuminating Engineering Society on the educational work that it was doing. Speaking as a factory inspector with more than a quarter of a century of experience, he felt that a good deal of the present efficient lighting was due to bodies of the kind.

He wished that Mr. Cooper had found time to deal with foundries, where, perhaps, there had been a greater advance than elsewhere. That, he thought, was at any rate partly due to the efforts of the Society.

The idiosyncrasies of workmen had been spoken about. He knew of a case where a man was grinding agricultural instruments in a dark recess in which there was only one gas bracket. The burner had been removed and there was merely a flare from the pipe. The workman regarded this form of lighting as the correct one for his work and said that he experienced no discomfort.

He hoped that Mr. Cooper would be able to extend his investigations to other trades. He was sure that they would benefit from them just as the engineering industry had done.

Mr. LEEVARS suggested that the £ s. d. of the question should be more fully emphasized. It was not only the lighting of machines that had to be considered in the lighting of engineering factories as a whole. If an increase of production of 15 per cent. could be shown to result from better illumination all hesitation to go in for efficient lighting systems would disappear.

Mr. W. E. BUSH said that Mr. Cooper had not stated how many of the people upon whom he had called during his investigations had wanted him to act as their consulting engineer! The information which the lecturer had gathered was certainly most valuable.

THE CHAIRMAN said that most of the points which he was going to raise had been anticipated by the various speakers. There were, however, one or two small points upon which perhaps Mr. Cooper would allow him to communicate with him.

His main duty was to propose a hearty vote of thanks to Mr. Cooper for his admirable paper. Whilst there had been many comments there had been extraordinarily few criticisms. He would like to see investigations extended to other industries, such as the textile and clothing trades. Each trade offered its own peculiar problems and many were behind the engineering industry in regard to lighting conditions.

Mr. L. GASTER seconded the vote of thanks. The paper, he said, contained a very interesting series of data, which deserved careful study. He noticed that according to one of the diagrams roughly 50 per cent. of the people interviewed considered artificial lighting important. He (Mr. Gaster) would like to know whether this percentage related simply to the number of firms approached, or whether any consideration was paid to the fact of some being much larger and more important than others. In conclusion, Mr. Gaster explained that it had been originally intended to hold the meeting at the house of the Royal Society of Arts, but this could not be arranged, and they were indebted to the E.L.M.A. Lighting Service Bureau for permitting the meeting to be held in their lecture hall at somewhat short notice.

Mr. C. A. MORTON (*communicated*):—

The author is to be congratulated upon the presentation of some extremely useful data. It is good to know that the standard of lighting equipment in the engineering industry is rising.

The glaring effect of the conical reflector usually met in the older installations is, in the main, due to the fact that the cut-off angle of these fittings is usually just around the horizontal. The discomfort caused is particularly important when this type of fitting is used for local lighting. When local equipment is still required personal discomfort arising out of glare will be reduced to a minimum if the type of fitting employed is one with a cut-off angle well below the horizontal.

A dark portion of a shop remote from windows, and possibly with the ceiling lower than the rest of the room, can be brought into full use by the liberal use of daylight-lamp equipment. It has been found, however, that the wattage expended in such an installation must be increased to a value greater than that usually met in ordinary installations in order that the resultant intensity may be comparable with that obtained from daylight. If the wattage is sufficiently high it should be difficult to detect any difference between the real and the artificial daylight. It is probable, where floor space is very valuable, that there will be many local areas where the reinforcement of daylight in this way will be economically worth while.

A remedy for reflected glare can usually be made by the insertion of a diffusing medium between the source and the objects to be examined. Such a medium could be thin sheet opal, or if glass is thought unsuitable for a workshop thin detail paper will make a good substitute that can easily be replaced. Either material can be mounted in a light frame at an angle suitable to the adjacent fittings. Examination of specularly reflecting specimens under such conditions can then be made without discomfort. Such an arrangement has proved successful in the lighting of electrical instruments where the mirror on the scales originally gave filament reflections. Where possible, all surfaces that will act as backgrounds should be matt, in order to reduce trouble from reflected glare.

The side lighting, as described on page 9 of the advance copy, must certainly be very objectionable. A light diffusing cover will reduce this trouble. Symmetrical fittings with a cut-off angle below the horizontal will give quite a good distribution of vertical illumination, and the discomfort will be considerably reduced.

The colour of walls is, perhaps, as important from the psychological point of view as from the point of view of illumination. Light-coloured walls are probably more useful in making a workshop healthy, clean and cheerful than in providing lumens for the working plane.

Mr. J. L. H. COOPER (in reply) agreed with Mr. Werner that both general and local lighting was necessary in workshops, and if the former was of a uniform character, of say 10 foot-candles intensity, the latter system would only be required at some individual machines engaged upon specific operations. It was ascertained in practice that if the general illumination was less than 8 foot-candles local light units were necessary on the majority of machines.

A uniform system of high intensity could be planned for a small workshop irrespective of plant layout, and any modification to the latter would not affect the lighting scheme, whereas a localized general lighting scheme would have to be rearranged in accordance with the alteration in machine layout. Another disadvantage (in addition to uneven lighting) of localized general lighting was the fact that while the maximum illumination was obtained at the tool point the minimum occurred at the driving end of the machine, which increased the accident risk. The shadow effect, which, of course, was an essential in work of a fine character, was illustrated by the example of die sinking, which necessitated the use of a local adjustable light unit for work of similar nature.

He agreed with Mr. Werner and Mr. Buckell that lamps of varying ages cause uneven illumination, and that it was advisable to renew these at stated periods.

Mr. Jackson had found from investigation that a uniform system of high intensity was a very satisfactory method of lighting power presses, etc., and that this system was applicable for all ordinary workshop purposes, and only specialized work required in addition local lighting. He thanked Mr. Jackson for contributing to the discussion; his remarks, as a manufacturer, were most valuable.

Mr. Buckell had mentioned two important matters, eye trouble and loss of time due to poor lighting conditions. The workers themselves in many cases complained of the brightness of the lamp (gasfilled) where local lighting or a modification of a local lighting system was employed. The raising of the light units from the direct line of vision was no doubt done in order to avoid eyestrain. No information was available on loss of time due to poor lighting conditions, but one was justified in assuming that such would be the case.

Mr. Gaster had suggested that some distinction should be made between large and small firms in connection with the tabulation of opinions expressed on the importance of artificial lighting. He (Mr. Cooper) thought that his remarks regarding the attitude of employers to lighting in both large and small works made this point clear, and 80 per cent. (not 50 per cent.) of the people interviewed considered artificial lighting as being important.

In conclusion, the author would like to express his appreciation for the kind reception given to the paper.

Twenty Years of Illuminating Engineering

IN the following pages we present a series of messages congratulating this journal on attaining its twentieth anniversary. As an introduction to these messages we are also presenting below a brief summary of events of interest in connection with illuminating engineering during the past 20 years.

Probably the first proposal to form an Illuminating Engineering Society in this country was that contained in the paper entitled "Progress in Electric Lighting," read by Mr. L. Gaster before the Royal Society of Arts on February 7th, 1906. The idea was developed shortly afterwards in a contribution to *The Electrical Magazine*, entitled "The Need for the Illuminating Engineer."

At the end of 1907 the idea was again presented by Mr. Gaster in a paper ("The Province of the Illuminating Engineer") read before the Society of Engineers-in-Charge, Mr. A. P. Trotter presiding. At that time the conception of "illuminating engineering" was unfamiliar, and some of those present expressed doubts whether such a society could be maintained. Mr. Gaster, however, in replying to the discussion, stated that the importance of the subject would be illustrated within a few weeks by the issue of a new journal, *The Illuminating Engineer*, exclusively devoted to illumination. It is now a matter of history that after the journal had paved the way by running for a year the Illuminating Engineering Society was duly launched. It has continued actively at work up to the present date, *The Illuminating Engineer* having acted throughout this period as its official organ.

The course of events in 1908 and subsequent years is roughly indicated by the following calendar:—

1908 Publication of the first issue of *The Illuminating Engineer* (January).

1909 Delivery of the first Cantor Lectures on Illumination before the Royal Society of Arts by Mr. L. Gaster (February 15th and 22nd; March 1st and 8th).

Decision taken to form an Illuminating Engineering Society at a dinner held at the Criterion Restaurant (February 9th).

Inaugural Meeting of the Illuminating Engineering Society, held at St. Bride's Institute (May 25th); *The Illuminating Engineer* adopted as the official organ.

First General Meeting of the Illuminating Engineering Society and address by the first President (Professor Silvanus P. Thompson, D.Sc., F.R.S. (November 18th).

Report presented by the Deputation of the Streets Committee of the City of London appointed to study the lighting of Continental cities.

Agreement reached by France, Great Britain and the United States on the "international candle."

1911 Report issued by Departmental Committee on Accidents in Factories and Workshops, containing recommendation that "inspectors should be given general statutory powers to require adequate lighting in all places where work is done. . . ."

Resolution passed at the International Electrotechnical Congress in Turin that the International Commission on Illumination should be formed.

Simultaneous series of lectures on Illuminating Engineering arranged at the Polytechnic (Regent Street), Battersea Polytechnic and the Northampton Institute.

1912 A Committee on the Hygienic Aspects of Lighting appointed in France.

Home Secretary agrees that a Departmental Committee on Lighting in Factories and Workshops shall be formed in Great Britain, in response to a question in the House by Mr. A. Lynch (May 16th).

Illuminating Engineering Society formed in Germany (November 2nd).

1913 Constitution and terms of reference of the Departmental Committee on Lighting in Factories and Workshops announced.

A Factory Lighting Bill presented to the New York State Factory Commission.

Proposed Government Commission on Illumination in Belgium.

A new journal, *Le Science et Art de l'Eclairage*, published in France.

Provisions for Good Lighting introduced into the new Indian Factory Act.

National Gas Exhibition held at Shepherd's Bush.

Proposals for Standard Clauses for insertion in a Specification for Street Lighting introduced in a paper by Mr. A. P. Trotter before the Illuminating Engineering Society (April 15th).

(N.B.—These clauses were framed by a Joint Committee representing the Illuminating Engineering Society and the Institutions of Gas and Electrical and Municipal and County Engineers.)

Reports issued by the Joint Committees formed by the Illuminating Engineering Society to consider the Lighting of Schools and Libraries.

Resolution to form an International Commission on Illumination confirmed, and representatives of the Illuminating Engineering Society on the National Committee appointed.

1914 Report issued by the Joint Committee formed by the Illuminating Engineering Society on Natural Lighting in Schools (July).

Outbreak of War.

Introduction of the Gasfilled ("Half-watt") Lamp.

1915 Committees formed to study the Illuminating Power of Flares, the Brightness of Radioactive Materials used for gun sights, etc.; Discussions on Lighting in War time; the Lighting of Rifle Ranges, Searchlights, etc.

First Report issued by the Departmental Committee on Lighting in Factories and Workshops.

1916 Suggestions made by the Society in regard to Economy in Lighting in War time.

Report issued by the Committee of the Illuminating Engineering Society on Research.

Importance of good factory lighting emphasized by the Health of Munition Workers' Committee.

A Code for the Lighting of Factories and Workshops issued in Washington (U.S.A.).

1917 Joint Committee on Illuminating Engineering appointed by the Department of Scientific and Industrial Research in response to a deputation from the Illuminating Engineering Society (March 6th).

Codes of Factory Lighting adopted in Pennsylvania, New Jersey, Ohio, and other States of America.

Formation of an Illuminating Engineering Society in Japan.

1918 Issue of Tenth Anniversary Number of *The Illuminating Engineer*.

Termination of the War.

1920 Report of the Joint Committee formed by the Illuminating Engineering Society on Eyestrain in Cinemas.

1921 Home Office Departmental Committee on Lighting in Factories and Workshops. (Issue of Second Interim Report.)

International Commission on Illumination; holding of the First Technical Session in Paris.

1922 Home Office Departmental Committee on Lighting in Factories and Workshops. (Issue of Third Interim Report.)

1923 Formation of the Illumination Research Committee under the Department for Scientific and Industrial Research.

1924 British Empire Exhibition at Wembley. Floodlighting a special feature. Conference on Illuminating Engineering at Wembley.

Formation of the Institution of Public Lighting Engineers.

Formation of the Illuminating Engineering Society in Austria.

1925 Issue of *The Illuminating Engineer* in a revised and extended form.

Development of the E.L.M.A. Lighting Service Bureau.

Formation of an Illumination Section by the British Engineering Standards Association.

1926 Formation of an Illuminating Engineering Society in Holland.

Issue of the British Standard Specification for Portable Photometers by the British Engineering Standards Association.

1927 Issue of Technical Papers on Various Problems by the Illumination Research Committee (Department of Scientific and Industrial Research).

Issue of the British Standard Specification for Street Lighting by the British Engineering Standards Association.

Meeting of the International Commission on Illumination at Bellagio.

A Series of Typical Messages to the Special Twentieth Anniversary Number of "The Illuminating Engineer"

Presidents and Past-Presidents of The Illuminating Engineering Societies in this Country and Abroad

Mr. D. R. Wilson (*President of the Illuminating Engineering Society*):

The twentieth anniversary of any organization is a clear indication that it has passed the stage of uncertainty and reached that of stability. *The Illuminating Engineer*, the journal of the Illuminating Engineering Society, is now celebrating its twentieth anniversary, and next year the Society will do likewise.

The Illuminating Engineering Society was designedly founded to be representative of the many diverse interests and professions involved in the practical use of light, and so may be regarded as typical, in a sense, of the progress made in the development of knowledge in regard to lighting and illumination. This development may perhaps be illustrated from my own experience, which has lain mainly in the field of industrial lighting. Shortly after the Society was founded I was deputed to investigate the lighting conditions in several industries. At that time comparatively few persons were specially interested in the scientific side of lighting, but I can still recall with gratitude the advice I then received from Mr. A. P. Trotter.

The contrast between conditions then and now is very striking. Many cotton mills, in some towns probably the majority, depended for their lighting entirely on naked gas flames, and where electric light had been installed carbon lamps were invariably used. Similar conditions were found in other industries, such as gas jets in foundries, where the dark surroundings called for the highest possible illumination, and even oil lamps in some factories visited by me.

The reason for these unsatisfactory conditions was not that improved and more efficient methods were not available, but that the managements and the workers were almost equally indifferent to the importance of lighting to well-being and efficiency.

The position now is entirely different. Good lighting is recognized as an essential factor in production, and, though there is doubtless still room for improvement in many factories, instances where the lighting is thoroughly bad are now the exception. The Illuminating Engineering Society and its journal have certainly contributed to the education of public opinion in this respect.

Then again, when we look back to the date of the Society's foundation, little knowledge of the conditions of illumination in practice, or of the conditions to be aimed at, was available. The first step to gain this knowledge was the appointment by the Home Office in 1912 of a Departmental Committee, which, in addition to collecting data showing the practice then existing, made recommendations as to the minimal requirements for the general lighting of factories, avoidance of glare and elimination of shadows, and also dealt to some degree with the lighting of fine processes. This Committee recognized that many problems could not be satisfactorily solved without further research, and was succeeded a few years ago by the appointment of two research committees, the one by the Department of Scientific and Industrial Research, the other by the Medical Research Council, to direct research on the physiology of vision. Both committees are still actively working.

Finally, it is suggestive of the advance made that, whereas the Factory Act of 1901 contains no reference to industrial lighting, the Factories Bill now before Parliament includes a section requiring good lighting in general terms and empowering the Secretary of State to prescribe definite standards by special order.

This short review is given to illustrate how, within the last 20 years, increasing importance has been attached to one important branch of lighting. Similar progress can doubtless be detected in the attitude of public opinion to other applications of light.

The work of the Society and its journal is therefore far from finished, and I venture to add a few words about the future. The scope of the Society is a very wide one. It is so constituted that it caters not only for the requirements of the experts in all methods of illumination but also for those who are interested in the subject in any of its many aspects. To become an expert calls for complete specialization and appropriate training. Apprehension of the general principles of good lighting is possible to everyone, and when the supremely important part played by light in our daily activities is recalled the inevitable conclusion is that the membership of such a Society as this should be far greater than it is at present. I would therefore invite those who read this note, and who, like myself, are not experts, to consider whether they should not show their interest in a subject which so vitally affects their lives by becoming members or associates.

The Society is the oldest of its kind in Europe. To have continued uninterruptedly for so long a time, including many difficult years, is a striking tribute to the ability and energy of the Hon. Secretary (Mr. L. Gaster) and the Hon. Assistant Secretary (Mr. J. S. Dow), who have also been continuously associated with *The Illuminating Engineer* since its commencement in 1908, and to whom all members will certainly wish on this occasion to offer their heartiest congratulations.

Mr. A. P. Trotter (*Past President of the Illuminating Engineering Society*):

Ten years ago I congratulated you on the completion of ten years of *The Illuminating Engineer*, which you had the courage to found in anticipation of a demand, the enthusiasm to develop on scientific lines, the skill to balance between competing interests, and the satisfaction of producing in so successful and attractive a form. At the end of twenty years *The Illuminating Engineer* has created a demand worthy of its merits; your enthusiasm has attracted physicists, physiologists, engineers, manufacturers, architects, municipal authorities, factory inspectors, and other Government departments to the study of illuminating as a branch of engineering.

Your sub-title "Good Lighting" is a reminder that your journal has recorded good lighting on sound technical lines in hospitals, schools, mines, picture galleries, theatres, printing works, textile and other factories, railways and docks, where formerly the lighting was carried out by those who did not know what good lighting was. Besides this *The Illuminating Engineer*, a technical journal of the highest class, has been of valuable service in connection with international conferences on scientific and industrial work in illumination, and informs its readers of developments in all parts of the civilized world.

Sir William H. Bennett, K.C.V.O., F.R.C.S. (*Past President of the Illuminating Engineering Society*):

Will you please accept my hearty congratulations upon the continued success of *The Illuminating Engineer* and on reaching its twentieth anniversary?

As the official organ of the Illuminating Engineering Society, the recognized authority upon all matters connected with lighting, it affords a striking example of the manner in which a publication of the kind should be conducted.

The lighting question is one of the first importance, and the value of *The Illuminating Engineer*, standing as it does for economy and efficiency in all its aspects, cannot, I think, be overestimated.

Sir John Herbert Parsons, F.R.S. (*Past President of the Illuminating Engineering Society*):

I learn with interest that it is proposed to celebrate the conclusion of 20 years of work of *The Illuminating Engineer* by the issue of a special Twentieth Anniversary Number, and I gladly take the opportunity of offering my congratulations on this event.

As you know, my own association with the Illuminating Engineering Society dates from its earliest stages, and I recall that one of the very first discussions before the Society was devoted to the analysis of glare, and that I had the pleasure of opening the discussion. On that occasion the importance of studying the physiological aspects of illumination and the effect of light on vision was emphasized. I am glad to think that since that date we have learned a great deal on such subjects, as is illustrated by the researches now being conducted by the Illumination Research Committee working under the Department of Scientific and Industrial Research. I feel that both illuminating engineers and the medical profession owe a debt of gratitude to your Editor for his constant efforts to bring them together and facilitate the solution of problems in which they are jointly interested, and also to *The Illuminating Engineer* for acting as the medium by which the results of such researches are made widely known.

Dr. E. P. Hyde (*Past President of the Illuminating Engineering Society, U.S.A.; Past President of the International Commission on Illumination*):

As you well know, I have not been, for several years, in intimate touch with the march of technical events in the field of illuminating engineering. . . . . It gives me pleasure, however, to revert to the long period of existence and service with which I am familiar—a glance backward over its past. *The Illuminating Engineer* began its career very shortly after the science and art of illuminating engineering was recognized as a distinct branch of engineering. The Illuminating Engineering Society of the United States was organized in 1906, and it was only two years later that the torch was lighted in England through the foundation of *The Illuminating Engineer*. Since that time, now 20 years ago, the light has burned steadily.

Illuminating engineering has long ceased to be an experiment; it has become an established and necessary fact. There are technical societies devoted to its development in many countries of the world, and the International Commission on Illumination, uniting the distributed efforts of national committees, has the promise of a useful future before it. Physics, chemistry and electrical and gas engineering have come together with psychology and the biological sciences to form a scientific basis of the new engineering branch, and a liaison has been formed with the æsthetic handmaidens of art and architecture. Illuminating engineering now rests on a broad and firm foundation, adequate to meet the exigencies of any ordinary lighting problem that may arise. It is not a complete science, not a finished art—indeed, it is yet in its infancy—but it has made wonderful progress since its birth scarcely more than two decades ago. During all this formative period *The Illuminating Engineer* has contributed conspicuously to its development and propagation.

I heartily congratulate *The Illuminating Engineer* on this twentieth anniversary, and I heartily congratulate you, its founder and editor, on the long record of useful service rendered.

Mr. L. B. Marks (*Past President of the Illuminating Engineering Society, U.S.A.*) writes that he appreciates the good work that has been done through the medium of the journal in the cause of good illumination, and he wishes to offer his congratulations on its success. . . . . There is no doubt whatever that international co-operation between those who have been identified with the lighting field has received great impetus through the publications in your journal.

Dr. L. Bloch (*Past President of the Illuminating Engineering Society in Germany*):

On the occasion of the twentieth anniversary of your journal, I desire to convey my best wishes for further progress and prosperity. Ever since it was started, your journal has specially interested me, and I have observed with pleasure that you have not been content merely to review developments in illuminating engineering in England, but have made a special feature of accounts of what is happening on the Continent and in other parts of the world.

Your journal has also aided in promoting the international drawing together of all those interested in illumination in different lands. We in Germany fully appreciate the opportunity which the journal affords not only of learning about developments in illuminating engineering abroad, but also of making known to others what is occurring in our own country. In common with us, lighting experts all the world over have cause to think with gratitude of your journal, and no less of yourself—its founder and editor for many years.

Mr. Preston S. Millar (*Technical Director, Electrical Testing Laboratories, New York; Past President of the Illuminating Engineering Society, U.S.A.*):

It is a pleasure to congratulate *The Illuminating Engineer* (The Journal of Good Lighting) upon its completion of 20 years of service in the advancement of lighting theory and practice. In disseminating not only British but also international lighting information, the journal is of material assistance in promoting understanding and acquaintance among lighting experts. I extend best wishes for an even more prosperous and useful future.

Dr. N. A. Halbertsma (*Secretary of the Dutch Illuminating Engineering Society*):

Twenty years are scarcely sufficient for a young man to prepare himself for a successful career. Yet *The Illuminating Engineer*, a journal which has the vigour and enterprise of youth, has, during the past 20 years, successfully paved the way for illuminating engineering at home and abroad. A keen interest in this subject now exists in nearly all European countries, but it should not be overlooked that you were responsible for starting the first journal in Europe to deal not merely with lamps but with illumination.

To-day, after 20 years, Great Britain is again giving a lead to the rest of Europe by the interest shown by its Government in industrial lighting. Here again we may, I think, trace the influence of your journal.

May I also refer to the important part played by *The Illuminating Engineer* as an international centre of illuminating engineering, from which information is distributed in all directions? No doubt the large circle of friends which you have created during your many trips abroad has enabled you to collect news from all parts of the Continent. I hope that this circle of friends will continue to expand, and to form one of the solid foundations of your journal, to which you have devoted so much effort during the past 20 years.

Professor A. E. Kennelly (*Professor of Electrical Engineering, Harvard University; Past President of the Illuminating Engineering Society, U.S.A.*):

I am glad to be reminded that *The Illuminating Engineer* is attaining its twentieth anniversary next month. I am also very glad to see that it is continuing its course of good public service in promoting the interests of illuminating engineering which are so vital to modern life. It is evident that a close connection exists between the degree of material civilization in any part of the world and the extent to which good lighting and illuminating engineering are developed.

I wish your journal all success in its accomplishments and in its recognition.

National and International Aspects of Illumination

Mr. C. C. Paterson (*President of the International Commission on Illumination*):

To those who remember the early days of Illuminating Engineering Societies, when the need for the illuminating engineer was not appreciated and his profession only imperfectly understood, the coming of the twentieth anniversary of *The Illuminating Engineer* serves to remind us how far we have travelled since those days, and how well founded was the faith of the pioneers who started the movement.

For it has now become world-wide. Those who are prominent in illumination matters in most parts of the world are united internationally in the International Commission on Illumination, which is supported now by the affiliation of 10 different countries. This Commission does not limit the independence of any of the national supporting groups, but it forms an organized means whereby regular international meetings are held for the purpose, firstly, of exchange of information and views, and, secondly, of securing international agreement where this is desirable.

There are few things so universal as light, and few subjects whose problems are so identical in different countries. The opportunities, therefore, for progress through international co-operation at the sessions, as well as between them, are very great, provided that all those individuals who work with the International Commission are also those who have the chief influence in illumination matters in the countries to which they belong. This object is secured when the Illuminating Engineering Societies in each country take the main responsibility for securing the representation of the national view internationally.

The liaison between the Illuminating Engineering Society and the International Commission on Illumination has been of the closest ever since the Society was founded, and as President of the International Commission I congratulate the Journal of the Society on its 20 years of valuable service, and wish it increasing usefulness and influence in the future.

Lieut.-Col. Kenelm Edgcumbe (*Chairman of the British Engineering Standards Association Sectional Committee on Illumination*):

I am interested to note that your journal has now completed 20 years of its career, and I should like to add my congratulations to the many which I feel sure you are receiving.

As Chairman of the British Engineering Standards Association Sectional Committee on Illumination, my inclination is perhaps to view matters chiefly from the direction of standardization, and in this your journal has rendered excellent service not only by keeping its readers fully posted as to the contents of specifications actually published, but also by drawing attention to what has been done or was in contemplation both at home and abroad.

I look upon it as a most encouraging sign that standardization is now making such rapid progress, and is being so widely recognized in the field of illumination —a field in connection with which, owing to the diversity of the interests involved, it is especially true to say that no lasting progress is possible until fundamentals have been standardized.

All good wishes for the continued success of your journal.

Professor André Blondel (*Paris*) and **Dr. Dziobek** and **Dr. E. Gehrke** (*Physikalisch Technische Reichstanstalt*) also send us congratulations and good wishes.

Dr. John W. T. Walsh (*General Secretary of the International Commission on Illumination*):

I am glad to take this opportunity of sending greetings on the occasion of the coming of age of *The Illuminating Engineer*. Those who are interested in the progress of good lighting in this country will be the first to realize how much the cause they have at heart owes to the twenty years of unceasing preaching which has taken place in the pages of the journal. Interest in the subject is increasing so rapidly at present that there is more need than ever for a journal devoted exclusively to all matters connected with lighting, and there is therefore every reason to hope and expect that the good work which *The Illuminating Engineer* has done in the past will continue and increase in the years to come.

Monsieur Paul Janet (*Director du Laboratoire Central d'Electricite, Paris*):

Progress in any science is not achieved by the efforts of a few isolated investigators alone, but is the result of the co-ordination of efforts by many. The science of illumination, like all others, obeys this general condition.

But in order to ensure this co-ordination of effort it is necessary that all workers should be kept in touch with results obtained in other countries, and that they should speak what is technically the same language.

It was mainly the desire to realize these conditions that led to the starting of *The Illuminating Engineer* 20 years ago. Agreement on the candle, the unit of luminous intensity, is to-day attained; international acceptance of other photometric units will not be long delayed. The founders of the Illuminating Engineering Society, who have so actively co-operated in establishing these international understandings have reason to be proud of their work.

Other Correspondents Abroad

Professor Elihu Thomson (*General Electric Company, U.S.A.*):

You are certainly to be congratulated on having completed 20 years of useful effort through the means of *The Illuminating Engineer*, and it is fitting that the event should be celebrated by the issue of a special anniversary number.

During this period of 20 years just past the science, art and practice of illumination has advanced with giant strides, but there will be, of course, a great open field for further development, depending on the special flexibility which electric illumination affords over all other types. It also lends itself to the production of the most artistic effects, and in this direction one can now see no limit.

Just at present we find great interest in the production and application of rays which cannot be said to be illuminating, but which are of the same general nature. The usefulness of ultra-violet radiation has been thoroughly demonstrated, if we are permitted to use the term "illumination" in reference to the invisible rays. The gap between the ultra-violet and the lowest of the X-rays has been closed, as well as that between the highest rays or shortest waves of wireless character and the lowest of the infra-red. In the same way, the rays from radioactive material, such as radium, have been connected up with the higher of the X-ray type. It is, indeed, difficult to assign limits to what can be done with this enormous range of wave frequencies, and, so far as illumination itself goes, many of the invisible rays are capable of exciting in special fluorescent materials visible light rays. I feel safe in predicting that the opportunities for usefulness for *The Illuminating Engineer* will not be diminished in the forthcoming 20 years.

Prof. Carlo Montu (*Comitato Elettrotecnico Italiano, Bellagio, Italy*):

Your immortal Shakespeare—admittedly one of the most profound thinkers the world has ever known—repeatedly extolled the glory of light. As just one example, I may mention the words of Cymbeline:—

> "Hark, hark! the lark at heaven's gate sings,
> And Phœbus 'gins arise,
> His steeds to water at those springs,
> On chalic'd flowers that lies."

Since their first steps on the road of evolution men, attracted by light, have not remained content with that received direct from the sun, but have sought for illumination from other sources, drawing from Nature her most jealously guarded secrets and utilizing her most mysterious energy. It can even be affirmed—not only in a figurative but also in a literal sense—that the march of civilization coincides with the development of better and better illumination.

Light is the glory of all the more civilized races and a common interest of all peoples; therefore in no other field of activity is there so great a necessity for international collaboration and the pooling of discoveries and initiative, etc.

Such an international exchange of ideas, with a continual development of illumination, has in your Society a vigorous animus, and in your journal, *The Illuminating Engineer*, a valuable aid; therefore, on the occasion of the twentieth anniversary of the latter, I gladly send to you and your admirable publication my most sincere greetings and a cordial message of good wishes, repeating the words of that noble man, Wolfgang von Goethe: "More light! more light!"

My sentiments are also those of the Italian people who, in the past year, have honoured the memory of Alexander Volta, whose discoveries have done so much for the cause of illumination; of the Italian people who have contributed so much work and genius to the age-long struggle against darkness.

Monsieur M. Bocquet (*Editor of the Bulletin of the Association Normande pour Prevenir les Accidents du Travail*) refers in cordial terms to the work of *The Illuminating Engineer* in the current issue of the Bulletin of this Association:

"During this period Mr. Leon Gaster has constantly advocated the systematic study of the principles of good illumination, and it is no exaggeration to say that he has induced manufacturing and business firms, public authorities and towns to adopt methods of lighting which are both scientific and economical. . . . . The admirably illustrated issue of this journal for October, 1927, which summarizes recent developments in public lighting, is particularly interesting. . . . This remarkable publication deals also with gas lighting, which in England continues to thrive in competition with electric lighting.

"We advise firms connected with our Association not to lose sight of the latest advances in illumination, by which important economies may be obtained."

(We learn that Monsieur Bocquet, after 30 years of useful work, is resigning his duties as editor of the journal of the *Association Normande pour Prevenir les Accidents du Travail*. In recognition of his services, the Association has conferred on Monsieur Bocquet the title of "Honorary Editor." The editorship will now devolve upon M. Delastre, who has been intimately associated with this movement for the promotion of industrial safety.—EDITOR.)

We have received from **Mr. S. E. Doane** (*Chief Engineer, National Lamp Works of the General Electric Co. Ltd., Cleveland, U.S.A.*), the following cablegram:

Please record my congratulations on twentieth anniversary of *The Illuminating Engineer*. I sincerely hope that it will continue for many 20 years, ever better and bigger and more effective in preaching the gospel of good lighting.

Sig. Carlo Clerici (*Associazione Nationale per lo Sviluppo dell'Illuminazione, Milan, Italy*):

Twenty years! An instant in the story of mankind—an era in the story of illumination.

A great part of electric lighting 20 years ago was still conducted with carbon-filament lamps. The wages of a workman in an hour's hard toil would have scarcely sufficed to pay for adequate lighting during that hour as we now understand it. To-day the workman, by only six minutes' effort, gains sufficient to cover the cost of proper illumination. In those days we had little conception of modern reflectors and diffusing units. Such terms as "lumen" and "foot-candle," to-day familiar, were little known. How many milestones have been passed in a score of years!

The *Associazione Nazionale per lo Sviluppo dell' Illuminazione*, which only a year ago commenced propaganda in favour of proper lighting in Italy, looks to *The Illuminating Engineer* as a pioneer which has opened the long path on which we now tread. It is notoriously difficult to extirpate bad habits, and to induce people to recognize that expenditure on good lighting is a wise investment, without which vision is not used to the best advantage, safety is endangered, work is inefficiently done and material is wasted.

But the example of *The Illuminating Engineer*, whose persevering efforts to spread abroad the precepts of good lighting extend over 20 years, should serve as an inspiration to illuminating engineers all the world over, who are grouped around it like a large family—thanks to its wide distribution and numerous contributors from abroad.

To this pioneering journal I extend congratulations and best wishes for an even more prosperous future.

Sig. Guido Semenza (*Italy*):

There is probably no technical field in which methods, means and necessities in various countries are more similar than in illumination. The international intercourse in illumination brings together forces all pointing in one direction; any progress made in one country is quickly acquired by others.

Your journal having always emphasized the importance of international aspects of illumination deserves our gratitude, for the ultimate result of such co-operation is to improve conditions of human life throughout the world.

Monsieur M. Leblanc (*Vice-President of the Societe Francaise des Electriciens; Secretary of the Comite National Francais de l'Eclairage*):

The Illuminating Engineering Society has had the rare merit of grasping early the important part played by lighting in relation to human activities, social and domestic alike. To enable mankind to attain good illumination is to launch him on a new career towards supreme progress—that marvellous goal which inspires the efforts of all scientists and disinterested engineers—however distant this goal may appear.

In encouraging theoretical study and experiment it has broadened the bases of scientific education. It has also recognized that the more completely the efforts of men of all nations are united in the age-long struggle against ignorance and prejudice the more quickly the desired goal will be attained. It has opened its ranks wide to lighting experts in other lands, and has been generous in the distribution of its journal, so that its sound conceptions on illumination may be spread abroad. All those who have followed these efforts must feel pleasure in conveying their best wishes on the occasion of your journal attaining its twentieth anniversary.

Mr. W. Trüb (*Manager of the Electricity Works, Zurich*):

It is the merit of the Illuminating Engineering Society and its journal to have contributed so greatly during the last 20 years to the enormous scientific progress in illumination.

The economic, hygienic and æsthetic importance of good artificial lighting has, however, not yet been thoroughly recognized by the community as a whole. No doubt much work still remains to be done. The science of illumination is still progressing and new problems await solution.

I appreciate highly the efforts of the Editor of *The Illuminating Engineer* towards international co-operation in this field. I wish to congratulate the journal on its twentieth anniversary, and sincerely hope that its very useful work may continue with ever-growing success.

Hygienic and Industrial Applications of Light

Sir Gerald Bellhouse (*H.M. Chief Inspector of Factories*):

On the conclusion of the twentieth anniversary of your journal I desire to send a message of congratulation. The question of adequate and suitable lighting is one which is being studied more and more by employers in industry, and there can be no question as to its importance from the point of view of health, safety and efficiency.

Mr. John A. Macintyre, B.Sc., M.Inst.C.E.:

The question is often asked by illuminating engineers familiar with Government practice why it is that the civil equipments of the Government, responsible as they are for hundreds of offices and other buildings throughout the country, do not lead the way in setting standards for the best forms of illumination in these buildings. We all know that it is a crime for a civil servant to speculate with public funds, and before the Treasury can agree to improvements on any installations they must be assured definitely that such improvements will react beneficially on output or on the health of the occupiers of the building in question.

No direct comparison between the electric current or gas bills and the staff output is possible, so that the Government, in common with most other light users, must depend on the educative influence of technical and scientific societies interested in illumination, and on such journals as *The Illuminating Engineer* to help them towards the solution of their lighting problems. This influence has been so effective during the past 20 years that many public offices are now lit almost as well as an engineer could desire, and Government engineers are encouraged to seek the help of the National Physical Laboratory to ascertain not what is the cheapest that will do, but what will be the most effective, while bearing in mind the urgent need for economy at the present time.

This policy has given a great stimulus to research work generally, as is illustrated by the fact that during this period, when the burden of the National Debt carried is greater than ever before, a special department has actually been formed to carry out such work.

The Illuminating Engineer is to be congratulated therefore, as it has taken no mean part in the building up of this progressive policy, and long may it continue to do its good work. Let us hope that during the coming decade not only will this work continue but the journal will be used more freely by Government engineers as a medium through which their difficulties and problems can be considered by independent scientists and experts.

Sir Thomas Oliver, M.A., D.Sc., F.R.C.P.:

As a physician interested in occupational diseases and in accidents occurring in mines and factories, I should like to tell you of the great assistance on several occasions your Society's journal, *The Illuminating Engineer*, has been to me. I do not possess sufficient knowledge to be able to express an opinion upon the technical papers which appear in the journal, but I can speak with confidence upon the high-class character and value of those which deal with the illumination of factories. The provision of adequate lighting is now recognized as a necessity, both from a hygienic point of view and as a preventative of accidents. Employers and employees alike gain by well-illuminated workrooms. By bringing brightness and cheerfulness into workrooms the monotony of toil is reduced and factory life made more pleasant. For this your journal has always pleaded.

Dr. James Kerr (*late Medical Officer, Public Health Department, L.C.C.*):

The Illuminating Engineer is to be congratulated on attaining another landmark. For a score of years it has been adding to the nation's wealth by its striving for efficiency and health. It has in that time, in the corner which I know, by demonstrating the need for good lighting, enormously eased the burden on the fifth of the population whose occupation is schooling. Of the hosts of interests in its columns in the past ten years, the two which remain most marked in my own experience are the solid comfort derived in continuous work from daylight lamps; and, again, the extraordinary limits to one's senses shown by the isochronous intermittent illumination, when the eye shows a machine apparently at rest, but the ear tells that it is running at high speed. I hope that the journal will continue for many years to carry forward the light that does not fail.

Technical Journalism

Sir Ernest J. P. Benn (*Managing Director, Benn Bros. Ltd.*):

Twenty years of serious technical and scientific journalism is an achievement which few can claim to have maintained. The lofty ideals and the high standard which you set before yourself in establishing *The Illuminating Engineer* in 1908 is an achievement not only of which you may be proud, but which should be a source of satisfaction and encouragement to all other technical journalists.

Mrs. M. A. Cloudesley Brereton (*Officier d'Academie, F.R.San.I., Hon.F.I.San.Eng., F.I.H.*:

It is a real pleasure to congratulate *The Illuminating Engineer* on attaining its twentieth anniversary. To keep pace with all the public needs that illuminating engineers are called upon to satisfy and to be thoroughly familiar with all the technical developments is not an easy task for anyone. *The Illuminating Engineer* has simplified it greatly. That this is a work of value, who can doubt? For the effective application of the science of illumination directly promotes safety and good health, whether of the man in the street, the child at school, the worker in the factory and office and every single person in his home. The economy of life and health and human efficiency for which good lighting therefore stands must give the Illuminating Engineering Society and the editor of its journal a pride and an enthusiasm in their work which I hope to see continuously reflected in these pages for many a long year to come.

The Lighting Industry

Mr. Frank Bailey (*Chief Engineer, City of London Electric Lighting Co. Ltd.*):

I must congratulate the journal, significantly called *The Illuminating Engineer*, on attaining its twentieth anniversary. During this period it has been recognized as the authority for recording progress in all matters referring to illumination. In making suggestions for improvements it has been of great service, and in preaching the doctrine of light, and yet more light, it has fulfilled a mission of great benefit, although, being a technical journal, it has not, perhaps, received the public attention its merits justify. In all branches of illumination there is still so much to be done that there could be a bright future in front of this journal. In the home, in the streets, and in all places of business or industry, it cannot yet be said that there is enough light. While efficiency in the conversion of electrical energy into light is higher, the cost of electrical energy is lower. Here are two reasons why we should have more light; and if *The Illuminating Engineer* will continue to educate the public and create a desire for still more light, the brightness of our lives will be increased, resulting in more work, better work, and greater happiness.

Mr. C. W. Sully (*Director of the E.L.M.A. Lighting Service Bureau*):

My Association congratulates the Illuminating Engineering Society upon having attained its majority, and wishes it every success in the future.

When your Society started the science of illumination was handicapped by the general practice existing at that time of relying upon points definitely fixed in central positions and illuminating all types of areas, and during its existence your Society has done much to advocate the advantages of distributing the lighting points in such a manner that with the assistance of suitable shades more even illumination can be obtained over any area.

Considerable progress has recently been made in connection with the science of illumination, so much so that the public is now beginning to realize the importance of this science through their observation of the improvements produced. The difficulty, however, still exists that the general public has very little opportunity of getting into direct touch with the illuminating engineer. In the future I hope that your Society will be successful in getting more and more in touch with those on whom the general public rely for advice in connection with these matters, and that your membership will embrace all sections of the industries that deal with illumination matters.

Mr. F. W. Goodenough (*The Gas Light & Coke Co.*):

Ten years have elapsed since I had the pleasure of congratulating *The Illuminating Engineer* on attaining its tenth anniversary. On the present occasion, marking the conclusion of 20 years of service, I wish again to refer to the excellent way in which it has served the good cause of scientific illumination. Throughout its history it has filled a unique position, and the able and careful manner in which it has presented the results of researches on illumination should be recognized by all associated with the lighting industries.

I hope that the journal will continue to flourish, and, if possible, to give even better service in the future than in the past.

Mr. Philip H. Sugg (*Director of Messrs. Wm. Sugg & Co. Ltd.*):

As one of the oldest firms engaged in the work of illuminating engineering, may we offer to *The Illuminating Engineer* (The Journal of Good Lighting) and to its Editor our hearty congratulations on the attainment of its twentieth birthday.

We feel sure that in the future the journal will continue to advocate the adoption of good lighting in every sphere throughout the country with even greater energy, and that the success attending its efforts will be of great value to the community in general.

Dr. Charles Carpenter (*South Metropolitan Gas Company*):

I have much pleasure in offering my congratulations to *The Illuminating Engineer* on the issue of its twentieth anniversary number.

Within the last few years the industrial, hygienic and physiological essentials of good illumination, based more upon a scientific and less upon an empirical point of view, have been the subject of a great deal of patient and fruitful research. *The Illuminating Engineer* has done much to encourage the practical application of many of the results of such research, and the solving of some of the problems associated therewith, and for this reason I sincerely wish it continued success.

Mr. H. Hepworth Thompson (*Managing Director, Holophane Ltd.*):

It is with great pleasure that I have your intimation of the twentieth anniversary of the founding of *The Illuminating Engineer*, because it signalizes the completion of a cycle of progress in this branch of engineering, in respect of which your journal has constituted a marked feature.

Many years have elapsed since the days of my first arrival in London, when my attention was first attracted by Mr. Gaster's correspondence in the papers relating to the science of good lighting, and the initiation and life of the Illuminating Engineering Society has been coincident with the growth in public opinion, as to the great part which illuminating engineering plays in public life to-day.

Much of the progress is attributable to Mr. Gaster's untiring enthusiasm and work for the cause, and I am glad to add my modest meed of appreciation both to him and the journal for the good work which they have done.

No more striking development has been manifested in the engineering field than that of lighting. Much still remains to be done in the way of broadening the scientific nature of the product, and I am sure that the change which has been made in the form of your journal, and the additional interest accruing therefrom, together with the wider aspect of the Society itself, will attain the desired result.

With hearty congratulations on the attainment of your majority.

Mr. J. Y. Fletcher (*General Electric Co. Ltd.*):

I am, as you know, a firm believer in the Illuminating Engineering Society and its journal, both of which my company and I have strongly supported for many years. It is, therefore, with great pleasure that I learn that *The Illuminating Engineer* has now completed 20 years of existence.

The value of light as a tool, as a crime deterrent, and its relation to output and spoilage are so little realized by the public that it is the duty of all men engaged in the lighting industry to bring home to every section of the community the importance of using plenty of light, and its correct application.

Undoubtedly one of the best means of attaining this end is through the medium of an energetic and progressive Illuminating Engineering Society and its journal—the first as a common meeting ground for every class of the community, every one of which requires light in some shape or form as part of its daily life, where lighting problems can be discussed and solutions arrived at; the second—the journal—as a means of recording and disseminating these problems and their solutions as widely as possible.

It is therefore my opinion that in the interests of better lighting the most energetic efforts should be made to increase the membership of the Illuminating Engineering Society and the circulation of the journal.

In conclusion, I congratulate *The Illuminating Engineer* on attaining its twentieth anniversary, and offer my best wishes for its future success.

Mr. P. J. Brewer (*British Thomson-Houston Co. Ltd.*):

On the completion this month of 20 years' publication of *The Illuminating Engineer*, you are so fully entitled to the congratulations and thanks of all those interested in illumination that I should be lacking in my duty if I were not to join in the chorus of good wishes which is sure to be raised on this great occasion.

Realization of what illuminating engineering is, and of its value to the public, exists to-day very largely in account of the good work done by you and *The Illuminating Engineer* in these 20 years.

However, even to-day, we have a long way to go before we can consider the needs of all classes to have been adequately met, and I look forward, therefore, with the liveliest sense of gratitude and thanks to the efforts which I know will be forthcoming in the future from the journal which you so ably edit.

With the full co-operation of societies and manufacturers and the distributing trade generally, we shall, I am sure, in a relatively short time, reach a condition of affairs in illuminating engineering which will justify us in feeling that we are really approaching the ideal. In this work I have every confidence that *The Illuminating Engineer* will continue to occupy the position which it has so ably filled in the past.

Mr. S. H. Callow (*Siemens Electric Lamps and Supplies Ltd.*):

I have great pleasure in congratulating *The Illuminating Engineer* ("The Journal of Good Lighting") upon completing 20 years of existence.

In January, 1918, I was one of the original members of the Illuminating Engineering Society who contributed a congratulatory message on the completion of the first ten years of existence of *The Illuminating Engineer*, and mentioned in that message that I had assisted Mr. Gaster with his paper read before the Association of Engineers in March, 1907, when it was decided to found the Illuminating Engineering Society.

Since that date I have become a member of the Council of the Illuminating Engineering Society and chairman of one of its committees, and have, therefore, had a better opportunity of realizing the useful work which the Society and the "Journal of Good Lighting" carries out in the interest of the science of illuminating engineering.

I am sure that all parties interested in this science will appreciate the improvements in the "Journal of Good Lighting" when compared with the original *Illuminating Engineer*, and will realize the much wider public to which the present journal appeals.

Due to the recent Electricity Act, there will undoubtedly be a considerable improvement in the use of electricity, both for domestic and commercial purposes, during the next ten years, and if this development is to be efficient, as far as lighting is concerned, it will be necessary for the industry in general to give careful attention to the scientific aspect of illumination.

In this connection the Illuminating Engineering Society and *The Illuminating Engineer* should play a most important part, and I not only, therefore, congratulate the Society and journal on having celebrated their twentieth anniversary, but I also offer to them my best wishes for every success in the future.

Mr. G. Campbell (*Managing Director, Benjamin Electric Ltd.*):

Success has attended the publication of *The Illuminating Engineer* since its inception, 20 years ago, and it now stands pre-eminent in its particular field of scientific literature, and is the recognized authority. Its cause no longer needs any explanation, and the fruits of its work are evident to all.

It is a very great pleasure to me to repeat the congratulations of 10 years ago.

Mr. H. Talbot (*General Manager, Welsbach Light Company*):

The foundation of the Illuminating Engineering Society 20 years ago, and the issue of its journal, coincided with the beginning of a new era in the better use of natural light and the more intensive application of artificial illuminants. From that date to the present the Society, through its spoken and written word, has consistently tried to guide the development of illuminating engineering in directions of the greatest national benefit, and the position to-day, both of the science and of the Society, is one of which the founders of the organization may well be proud.

All honour to those who have laboured so fruitfully in the past, congratulations upon present achievements, and best wishes for abounding success in the future.

[*We should like to record the receipt of various other messages which arrived after this issue had gone to press; amongst these we may make special mention of the contribution by Dr. Hans Koch, of Vienna, dealing with International Co-operation in Illuminating Engineering.*

Amongst other messages received when this journal was at the point of going to press we may mention cordial communications from Dr. Clayton H. Sharp and Mr. M. Luckiesh, both Past-Presidents of the Illuminating Engineering Society in the United States, and whose names will be familiar to our readers as the originators of much valuable experimental work on illumination and photometry. We have also to acknowledge the receipt of an appreciative message from Professor F. C. Caldwell, of Ohio State University, who, it may be recalled, contributed a very useful survey of the 1927 *Report of the Committee on Street Lighting of the Illuminating Engineering Society (U.S.A.) to the last issue of "The Illuminating Engineer."*

Finally, we have received congratulations from Dr. H. Lux, who was for many years associated with the "Zeitschrift für Beleuchtungswesen," a journal published in Germany which reviewed both gas and electric lighting, and was amongst the first to be devoted to illumination. Dr. Lux also favours us with an interesting original article dealing with the actinic value of various sources of light.

These, and other messages received, must be reserved for our next number—ED.]

Road Traffic Signs and Signals

We are asked to mention that a meeting devoted to the demonstration and discussion of Road Traffic Signs and Signals has been arranged by the Institution of Public Lighting Engineers, and will take place at the E.L.M.A. Lighting Service Bureau (15, Savoy Street, Strand, London, W.C.), at 7-30 p.m., on Tuesday, February 21st.

Members of the Illuminating Engineering Society will be cordially welcomed.

We understand that the Conference will receive the support of Sir Henry Maybury, the Director of General Roads, and the Ministry of Transport, and that other organizations interested in traffic problems will be represented.

The proceedings will be opened by a brief introductory paper by Mr. W. J. Jones, and after the discussion light refreshments will be served at 9 p.m., when an opportunity of inspecting the various exhibits will be afforded.

The use of luminous traffic signs and indicators constitutes quite a new field in illuminating engineering, and the discussion should be of considerable interest to members of the Illuminating Engineering Society.

POPULAR & TRADE SECTION

COMPRISING

Installation Topics—Hygiene and Safety—Data for Contractors—Hints to Consumers

(The matter in this section does not form part of the official Transactions of the Illuminating Engineering Society; and is based on outside contributions.)

A Review of Lamp Progress in the Last 20 Years

By H. LINGARD

(*E.L.M.A. Lighting Service Bureau*).

THERE are few, if any, sciences which can record a progress in application as great as that made by the science of lighting in the short period of the last twenty years, and this in spite of the great upheaval of 1914–1918. Twenty years ago the electrical industry was certainly well established, although current was, on the whole, expensive, and the areas where supply was available were very limited. A new light source had, however, appeared on the market, and due to its much higher efficiency compared with its predecessor—the carbon lamp—promised to create an enormously increased demand for electricity. For many years, almost from the date of the first carbon lamp, investigators had applied themselves to the discovery of a suitable metal which could be satisfactorily employed for the filament of the incandescent lamp, and when, by one of those fortunate accidents which have, from time to time, rewarded the patient scientist, it was found that the metal tantalum could be rendered ductile and capable of being drawn into a wire, the era of universal electric lighting had indeed commenced. The tantalum lamp, however, represented only a milestone in the romantic history of lamp development, and due to certain inherent disadvantages was shortly superseded by the vacuum lamp with a tungsten filament, a type which still finds many applications at the present day.

The Tungsten Lamp.—The research work necessary before tungsten could be formed into a filament is of sufficient interest to deserve an article on its own. For the time, nothing could have seemed more hopeless than to make a practical filament out of tungsten. After a process of refining tungsten is obtained in the form of a fine powder. Making "ropes of sand" seemed to be just as easy as transforming this powder into the thin tough filament required for an electric lamp. Nevertheless, remembering how cotton wool was changed into hard carbon, inventors set to work on the apparently impossible.

Their first attempt was heroic, and in a large measure successful. They mixed the powder with a binding material into a paste, and the paste they squeezed through a diamond die—that is to say, through a minute hole in a fragment of diamond. A fine thread was thus formed, and the binding material was afterwards burned out by means of an electric current. The result was a fragile filament with one redeeming virtue—it gave *four* times the light of a carbon filament for the same amount of electrical energy. The fragility of the squirted tungsten filament represented an obvious disadvantage from the point of view of commercial application, and the drawn tungsten filament lamp, which rapidly succeeded the carbon lamp, gave the consumer a highly efficient light source, which was sufficiently robust for all practical purposes. One of the early difficulties in the manufacture of the metal-filament lamp was the accommodating of about three feet of filament in a small bulb, and this was ingeniously overcome by the process now commonly used in metal-filament lamps, known as squirrel-cage winding.

The Gasfilled Lamp.—Hitherto all the filaments of incandescent lamps had operated in a vacuum. In 1913 the next big step forward in the development of the lamp industry was brought about by the introduction of the gasfilled lamp, and this lamp represented the result of a thorough scientific investigation into the causes of blackening in the ordinary vacuum tungsten lamp.

The Development of the Gasfilled Lamp.—The following arguments led the inventor, Irving Langmuir, to the production of what is still the most efficient type of incandescent lamp.

The efficiency at which tungsten lamps may be profitably run is limited, principally by the blackening of the bulb, and it had usually been considered that this blackening was due very largely to the presence of water vapour.

Attempts were then made to improve the life of lamps by the more complete removal of the water vapour, but this only resulted in failure, and it was, therefore, concluded that although water vapour was usually the cause of short life in a lamp that has been badly exhausted it was not the cause of blackening in a well-exhausted lamp. Research showed that the actual cause of blackening in a well-exhausted lamp was due entirely to evaporation of the filament, and it therefore followed that, to improve the efficiency of lamps, either the rate of filament evaporation must be reduced or evaporating tungsten must be prevented from blackening the bulb. The following methods of improving the tungsten lamp, and thus increasing its efficiency, were then experimented with, namely:—

(*a*) Introduction of inert gases, such as nitrogen, into the bulb at atmospheric pressures.

(*d*) Changing the location of the deposit by means of convection currents in gases, so that the bulb opposite to the filament does not blacken.

To the two methods mentioned by Langmuir must be added the fact that it is necessary to have a large-diameter filament. It is obvious that the introduction of gas into the bulb has the effect of cooling the filament, and therefore results in a wastage of electrical energy by convection. It was found that the actual heat lost by a filament was practically independent of the diameter, so that a filament of large diameter carrying a heavy current could afford to bear this loss better than a thin filament. Success was achieved by keeping the heat loss as small as possible by employing a large diameter filament or by using a spiralled filament.

(*Continued on p.* 26.)

The British Thomson-Houston Co., Ltd., Crown House, Aldwych, London, W.C.2

The higher efficiency of the gasfilled lamp compared with a vacuum lamp is really the result of a race, and by using a larger-diameter filament it is possible to win the race, and win it so comfortably that not only can the original net efficiency of the vacuum lamp be reached, but a higher efficiency obtained. The use of large-diameter filaments would seriously limit the number of types of lamps which could be improved by gasfilling but for the extremely valuable discovery made by Langmuir that a thin filament can be given the equivalence of a thick filament so far as heat losses are concerned by the simple expedient of spiralling the wire, and it is nowadays possible to market efficient gasfilled lamps from the 40-watt size upwards.

Leading-in Wires.—At one time it was necessary to employ the metal platinum for leading-in wires in electric lamps, due to its having the same coefficients of expansion as glass itself, and therefore maintaining a perfectly gas-tight joint at the point of entry. Platinum is, of course, a very expensive metal, and lamp manufacturers are now employing an inexpensive platinum substitute which consists of nickel-iron core, coated with copper, and this alloy serves exactly the same purpose as its more expensive predecessor.

Uniformity of Product.—One of the chief improvements in the process of lamp manufacture has been the elimination of almost all handwork on the product. Automatic machinery is now employed in almost every one of the manifold operations involved in lamp manufacture, thus ensuring that uniformity of product so obviously essential in the manufacture of light sources, and, by the employment of machinery specially designed for each individual operation, this uniformity has been still further increased during recent years.

Lamp Standardization.—A considerable step forward from the lamp user's point of view was achieved when the characteristics of electric lamps manufactured by the associated companies of E.L.M.A. were standardized by the British Engineering Standards Association Specification No. 161, 1924. This specification not only ensures that any lamp made by members of E.L.M.A. can be relied upon to give a definite light output and have an average light of 1,000 hours, but it also controls the lamp length, bulb size and light-centre length, so that lamps of different manufacture will be satisfactory for use in any given fitting.

Varieties of Lamps.—During the period under review a multitude of different lamps have evolved for special purposes, and there are now available lamps for use in almost every branch of human activity. The gasfilling process has been successfully applied to the small lamps used in the rapidly growing field of automobile lighting, while for many special applications in medical work, projection work, etc., the gasfilled lamp has been adapted to suit the requirements of each particular application.

Avoidance of Glare.—One of the objections arising from the use of the gasfilled lamp, with its high intrinsic brilliance, is that unless employed in suitable lighting fittings the lamp is liable to become a source of glare —hence the introduction of the diffusing bulb.

Obscured Lamps.—Among the three most successful attempts in this direction may be noted the white-sprayed lamp, the opal-bulb lamp, and the still more recent inside-frosted lamp. The first two lamps mentioned provide a very complete diffusion of the light at the bulb surface, and are suitable for positions where the lamp is used in the line of vision, or where complete diffusion is essential. The inside-frosted lamp, on the other hand, achieves rather less diffusion, although it absorbs an almost negligible amount of light in doing so, thus providing a satisfactory light source for the user who is concerned with obtaining utmost efficiency.

Coloured Lamps.—The application of spraying the surface of lamp bulbs has not only been applied to obtain diffusion, but by the introduction of colour pigments into the spray has made possible the adoption of a wide range of colour-sprayed gasfilled lamps which, in their deeper tints, have considerable possibilities in decorative lighting schemes, while in their lighter tints they possess great potentialities in the home and in the lighting of festive interiors.

The Daylight Lamp.—Another type of gasfilled lamp which is finding increased popularity is that with a blue glass bulb, known as the daylight lamp. This blue glass has the effect of filtering out from the light emitted by the filament the surplus red and orange rays, whilst it transmits the blue and green part of the spectrum almost unmodified. The resulting illumination from this lamp is, therefore, very closely comparable with that of natural daylight, and although not sufficiently accurate for exact colour matching there are many applications for this lamp where light of an approximate daylight character is required after nightfall.

Lamp Makers' Service to Other Industries.—It should be borne in mind when considering the activities of the lamp industry during the last 20 years that considerable service has been rendered by that industry outside its own immediate province, for example in connection with:—

(1) *Modern X-Ray Tubes.*—W. D. Coolidge, inventor of the drawn-wire process for tungsten lamps, has made all X-Ray workers his debtors by the improvements he has effected in X-Ray tubes.

(2) *Commercial Argon and Neon.*—It is not many years since the classic work of Ramsay and Rayleigh revealed the presence of certain inert gases in the atmosphere. To-day, largely owing to the demand for these gases in the lamp trade, it is possible to purchase argon and neon in commercial quantities.

(3) *Thermionic Valves.*—These lamps are a direct product of the lamp industry.

(4) *Lightning Arrestors.*

(5) *Advances in High-Temperature Measurements.* (*Pyrometry.*)

(6) *Contributions to Our Knowledge of the Structure of the Atom.*

(7) *Refined Methods of Analysis of Gases.*

Also, of course, the lamp industry is largely responsible for the great development in electrical supply and distribution and the general application of electricity to the service of mankind, which is becoming ever more extensive as time progresses.

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Exhibition of Recent Lighting Appliances

(Arranged at the Opening Meeting of the Illuminating Engineering Society, held at the E.L.M.A. Lighting Service Bureau, at 7 p.m., on Tuesday, November 22nd, 1927)

A New Road Sign Illuminator.

The first item amongst the exhibits was a demonstration by Mr. S. J. Patmore of a very simple and compact form of Road Sign Illuminator, capable of being attached to existing signs. Mr. Patmore, in opening his description, remarked that everyone would concede that road warning signs of some sort or other were essential. Confirmation of this statement was furnished by reference to the numbers of Ministry of Transport danger signs already fixed throughout the country. These, however, unfortunately usually ceased to function at dusk—the very time when they were most required.

With this in mind the General Electric Co. Ltd. had designed and developed a unit which could be easily and quickly attached to any standard Ministry of Transport danger sign with a minimum of trouble, thus making the sign itself work from sunrise to sunrise instead of, as previously, from sunrise to sunset.

The unit consisted of an aluminium case fitted with three small triangular lugs. It was fixed in position by placing these lugs inside the triangle itself and tightening three triangular washers with set-screws, as seen in the illustration.

To the case a lamp holder containing a 20-watt Osram sign-type lamp was fitted, and also a special reflector cap for illuminating the triangle; a swan-neck bracket carrying vitreous-enamelled shade and a 40-watt Pearl Osram gasfilled lamp illuminated a board conveying the warning message. The unit itself formed a complete article, and included a sealing chamber for a service cable, a pair of fuses, and a time switch for lighting and extinguishing the lamps at predetermined times.

A sign fitted with one of these units was easily discernible at a distance of 500 yards. At recent meetings of the Institute of Public Lighting Engineers and the Illuminating Engineering Society stress had been laid on the necessity for standardization of road signs, and a committee was now sitting to discuss the question.

In view of the numbers of standard Ministry of Transport Signs in use throughout the country, their usefulness during daylight hours, and the general need for economy, it was suggested that these signs, fitted with an illuminating attachment such as I have described, should form the basis of such standardization.

Day Colour Light Signals for Railways.

Mr. T. Austin (The Siemens & General Electric Railway Signal Co. Ltd.), in introducing this device, stated that the comparatively recent adoption of colour light signals on the railways in the British Isles afforded a reason for bringing to the notice of the Illuminating Engineering Society an actual example of the type of signal employed.

These signals take the place of the familiar semaphore signals which have done duty for upwards of 80 years, and offer many advantages over the latter type.

The range of visibility of the light signal varies with the power of the lamp employed, and with a 24-watt filament, as used in the example demonstrated, a visibility of 4,000 feet in brightest sunshine is easily obtainable; while in darkness, and under raining, misty or similar conditions, the light signal shows up to particular advantage. The absence of exposed moving parts and general compactness are but two of the many points in favour of the light signal.

Three colours are usually employed in railway signalling, and these are red, yellow and green. These may be combined as two-aspect (red and green), three-aspect (red, yellow and green) or four-aspect (red, green and two yellows). The meaning of the aspects are: *Red*—Stop; *one Yellow*—Caution—be prepared to stop at next signal; *two Yellows*—Caution—run at medium speed; *Green*—Proceed.

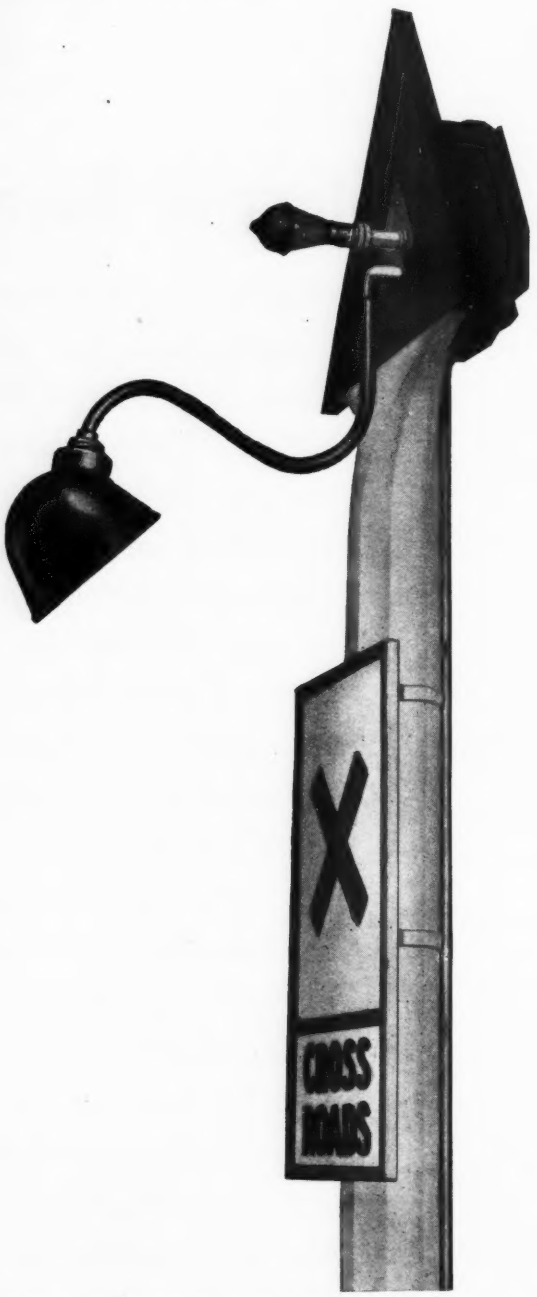

Fig. 1.—A General View of the G.E.C. Road Sign Illuminator.

The signal consists essentially of a series of compartments, each of which is fitted with an electric lamp and special lens system. The lenses employed form what is known as a "doublet combination," comprising an inner coloured lens and an outer clear white lens. The inner lens is an inverted stepped lens of $5\frac{1}{2}$ ins. diameter, while the cover lens is a normal stepped lens of $8\frac{3}{8}$ ins. diameter. The employment of the white cover lens is to avoid any reflection of coloured light which might lead to an improper phantom indication being given to a train driver.

The beam transmitted has a normal spread of 6°, which is sufficient for the usual curvatures met with on railways, but to cater for sharp curves special cover lenses are employed. These are moulded with prisms on the outer surface, giving varying degrees of spread according to the shape and size of the prisms.

The wider dispersion of the beam naturally results in a reduction of the distance at which the signal can be seen, but as the visibility on a sharp curve is restricted the reduction of range is no disadvantage.

As in the standard signal the beam transmitted is nearly a parallel one, it follows that where signals have to be mounted above the line of the driver's vision there may be some difficulty in his being able to see the indication at close quarters. To overcome this, in the example displayed, prismatic deflecting surfaces are built into the outer lens over a small sector giving sufficient area of outward spread to be of use when close up to the signal while not seriously interfering with the main beam.

FIG. 2.—Example of Colour Light Signal for use on Railways.

With the lens combination previously described it is necessary to use a concentrated-filament gasfilled lamp in order to obtain a sufficiently intense beam, and in this connection it should be noted that reflectors of any kind cannot be used. It will be appreciated that the use of any reflecting surface may lead to dangerous phantom indications being given. The source of light in this type of signal is a low-voltage lamp having two concentrated filaments and consuming about 24 watts in its main filament. An auxiliary filament of lower wattage and less efficient rating is connected in parallel with the focal filament, so that in the event of a failure of the main filament the signal still gives an indication, although somewhat restricted.

As the focussing of the lens system is very sharp, specially designed lampholders have to be employed. Adjustment in three directions is provided, and this is carried out at the works, after which the lampholder is securely fixed, and cannot readily be altered.

In order that the exchange of lamps shall not affect the efficiency of the indication and, further, that the onus of focussing shall not be placed on the maintainer, the lamps used in these signals are specially capped. A standard bayonet cap having three pins spaced at unequal distances ensures that the lamp is placed in the holder with the filaments in correct relationship with the lens. The height of the filament with respect to the pins on the cap is adjusted to small limits by means of a brass sleeve fitting inside the cap. Thus, within comparatively small limits every lamp is identical.

To align the signal to the track a form of rifle sight is provided on the case, while a conical surface inside the socket at the bottom allows of a limited amount of universal adjustment.

The lamps are usually supplied with current from a small transformer fixed inside each aspect, which converts the high-voltage line supply to 12 volts for the lamp filaments.

"MUR-RAY" SIGNS.

Mr. L. C. JOHNSTONE (Mur-Ray Signs Ltd.) exhibited a variety of "Mur-Ray" signs. He explained that the essential features of the lens involved, firstly, the special plano-convex lens, with a length approximately twice the diameter, and the concave mirror reflector, composed of pure silver rolled on copper. The mirror is attached to the plano end of the lens by means of a special cement giving excellent optical contact, and it is protected further by means of a special tapping, a metal cylinder with a specially constructed base. Light passing through the convex end of the lens is reflected by the silvered mirror at the back, but the light gathered a magnification of about $3\frac{1}{4}$ in the case of a large-size lens, and the volume of light is correspondingly accentuated.

The chief use of signs composed of these lenses was probably as a safety device, e.g., for triangles, cross-road signs, right and left hand turns, etc., which have become standard and are installed by local surveyors throughout the country.

The next most important use was probably for purposes of publicity, and any motorist would corroborate the great increase in the number of such signs displayed during the last two years — whereas only two years ago the number was negligible. An obvious advantage of such a sign was that it could often be used in isolated spots where no electrical supply was available, and where it stood out in a striking manner. The cost of upkeep was very small. An occasional coat of paint or protective covering was all that was needed. This might be done annually to keep the sign in good condition, and thirty years was regarded as a reasonable period of effective life. Even then the lenses would probably be found intact. In cases where decay of wooden backing deserved consideration the lenses could be incorporated in a solid metal sign, or letters of cast iron or aluminium could be adopted according to the purpose which the sign had to fulfil. Letters as small as 3 inches are being made in aluminium—one example being the adoption of signs carrying the name of cars for attachment to the rear of all vehicles made by a certain firm. Such a sign would usually be visible at least a quarter-mile away in the beam of a good standard headlight.

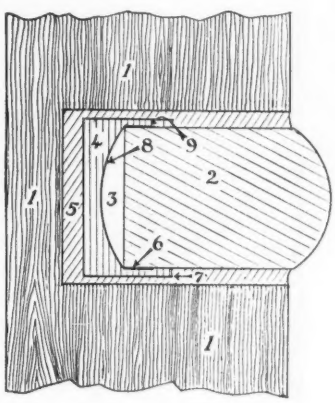

FIG. 3.—Diagrammatic Sketch of Lens used in "Mur-Ray" Sign.

The lens sign could be adapted to meet almost any requirement, and the possibilities would be understood

FIG. 4.—Appearance of Typical Sign for Information of Motorists.

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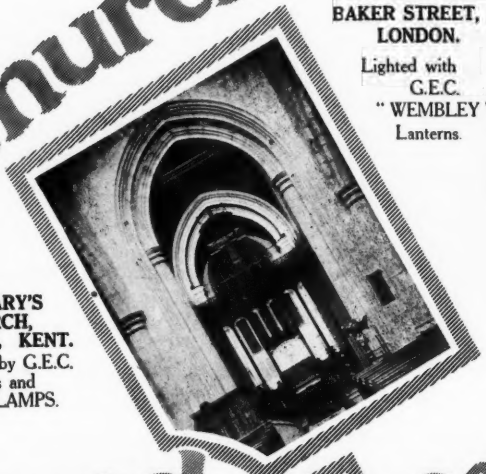

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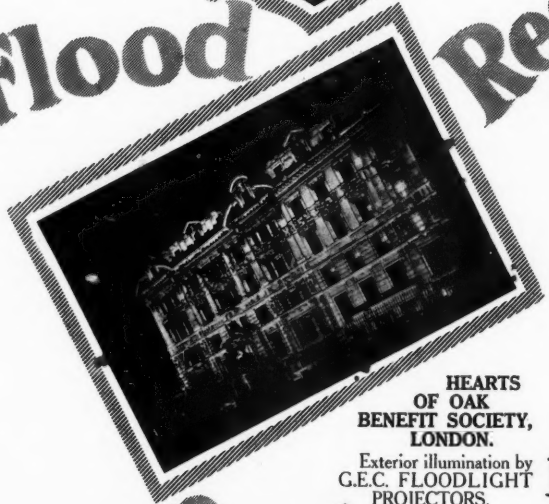

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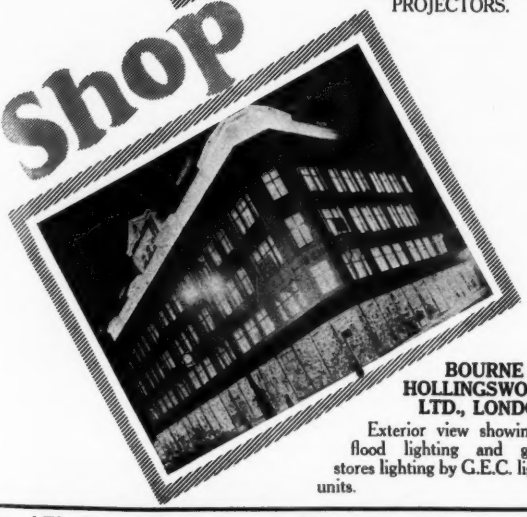

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from the fact that expression could now be given to faces outlined in this way.

Whilst such signs often gained sufficient brilliancy from the stray light from public lamps or from the beams of motor headlights, in the case of special advertising signs arrangements had been made to floodlight them from a considerable distance. In such cases the effect of the sign, seen from a considerable distance, was very striking. The method was obviously a most economical one in consumption of electrical energy, as compared with signs composed of a large number of electric lamps, besides the fact that the general design was not liable to be impaired by the extinction of some of the lamps from time to time.*

Stage-Lighting at the Albert Hall in the Opera "Mozart and Salieri."

Mr. L. G. Applebee (The Strand Electric and Engineering Co. Ltd.) gave a brief description of an interesting piece of lighting at the Royal Albert Hall, where a new departure in lighting was introduced for the above opera by the producer, Mr. Frank Collins, in conjunction with Mr. Arthur T. Earnshaw, of the Strand Electric and Engineering Co. Ltd. Huge curtains and borders were erected, completely covering in the organ, whilst the usual orchestra platform was extended into the arena, making a flat stage and tableau curtain 100 square feet in size, suspended from the roof to form a proscenium. The orchestra were seated on the arena floor.

To light this large stage was at first thought to be extremely difficult. The use of footlights was entirely out of the question, as the upper portions of the curtains had to fade into darkness. Finally, Mr. Earnshaw decided to hang from the centre of the dome twelve 1,000-watt projector lanterns, which were concealed by a green curtain. The throw for these lanterns was 60 feet. Immediately above the stage, 60 feet up, were installed eight more lanterns of the same type. All the lanterns were directed

Fig. 5.—Lanterns used by the Strand Electric in connection with the Opera "Mozart and Salieri," at the Royal Albert Hall.

to light the stage floor and characters. The results were so good that it was found that only half the number of lanterns in each case was found necessary. The lanterns were therefore divided into two circuits, one giving dark amber lighting and one a pale straw colour. All were operated through "Seecol" metallic dimmers situated at the stage manager's desk.

The above example of lighting is a great step in the progress of the projector gasfilled lamp. Only 10 kw. were required for the illumination of the whole of this huge stage. If arc lamps had been used the current consumed would probably have been more than double, whilst the dimming effect could not have been obtained.

Mr. Applebee then exhibited lantern slides of two types of modern dead front stage-lighting switchboards and regulator, the first showing that installed at the Glasgow Alhambra. The second slide shown was of a more recent design, and boards of this type have recently been installed at the King's Theatre (Glasgow), Lyceum Theatre (Edinburgh), the Mile End Pavilion, Theatre Royal (Glasgow), and the East Ham Palace. The boards are extremely well designed for stage work, and being dead front the Home Office six-foot rule between outers is avoided, and thus the switchboard operator has a compact piece of apparatus which can be efficiently worked by one man from the centre.

The next slide shown was of the New Carlton Theatre stage, the very latest theatre to be built in London. The well-known "Sunray" magazine battens were clearly shown. These battens and footlights are now in use in most of the London theatres, such as Drury Lane, the Hippodrome, the Palladium, His Majesty's, the Gaiety, Daly's Theatre, the Vaudeville, etc.

Finally, Mr. Applebee demonstrated the "Stransign" interchangeable sign, by means of which the titles of plays, or films, can be quickly changed without any disconnection of the electric wiring, and so simply arranged that the changing of the title can be carried out by any person, even if they have no knowledge of electrical work.

Two Interesting Special Lamps.

Two interesting novelties, the "Duo-Photo" lamp and the "Duo-Savelite" lamps, were shown by Mr. Harris (Philips Lamps Ltd.), who explained that the Philips "Duo-Photo" lamp had been introduced to provide photographers with alternative illuminants from the same source in the dark-room—one for general illumination and the other for development and processes involving exposure of sensitized media to light. This is rendered possible by containing two filaments in one globe of opal glass, one filament being further shielded by a ruby glass bulb. Either filament is actuated by means of two cords controlling a switch in the cap. Thus it is possible to have service in one lamp of a red light suitable for developing and of a soft white light for printing and finishing manipulations. The consumption for either filament is 40 watts.

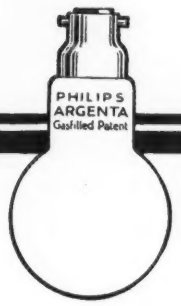
As a point of interest Mr. Harris also mentioned that Philips laboratories are now engaged in perfecting a lamp of similar design, but giving alternatively white or yellow light, for gaslight or bromide papers.

With the Philips "Duo-Savelite" lamp dual intensities are available from filaments consuming 25 or 44 watts, which are brought into operation by means of two hanging cords controlling a switch in

Fig. 6.—The "Duo-Photo" Lamp.

* Mr. A. Cunnington sends us the following note on the above exhibit: Referring to the demonstration of "Mur-Ray" signs at the recent meeting of the Society, it may be of interest to mention that the Southern Railway have experimented with "Danger" signs picked out in letters of this type for use at level crossings where the line of approach is such as to give comparatively little warning of the existence of the crossing gates. The trials carried out showed that the word "Danger" in 6-inch letters was very brilliantly shown up at a distance of about 100 yards by no greater illuminant than an ordinary acetylene headlight of a motor bicycle. The experiments tended to show that the most vivid effect was obtained when the headlights impinging on the letters were not too bright. With brilliant motor-car headlights at short range the contrast between the illuminated letters and the background rather minimized the effect produced. The demonstration at the meeting appeared to me very disappointing, and I think the chief reason was that the letters were placed at very close range in a very high candle-power beam. The device is certainly quite effective for the purpose indicated above.

PROGRESS



1928

Numerous branches throughout the world have been opened which possess the same virile progressiveness as the parent concern.

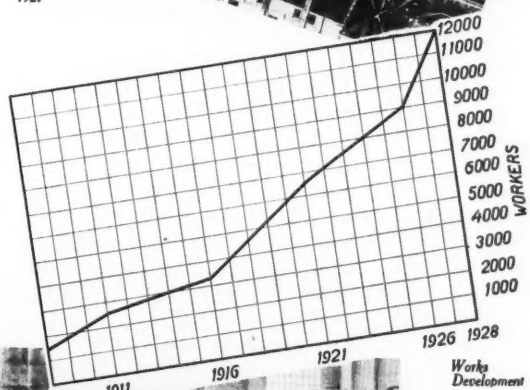
During the last twenty-five years many discoveries, important to the Physical and Scientific World, have emanated from Philips Laboratories. Here the Argenta lamp, used everywhere, was perfected, and the Metalix X-ray tube, a boon to all radiologists, had its beginnings also.

This laboratory too made it possible to span the world by radio, transmissions being made on a short-wave length of 30·2 metres.

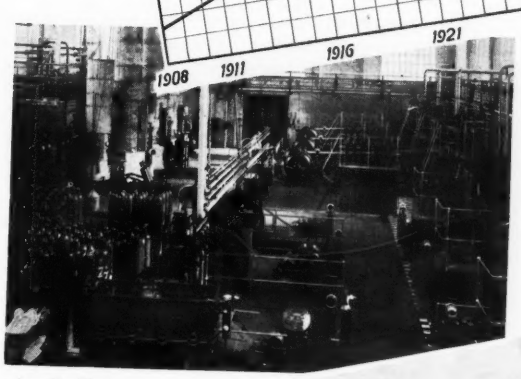
Leading scientists have recognized this laboratory as is evinced by a recent statement of Prof. Compton, the Nobel Prizewinner for Physics 1927, who stated that he considered they were a serious competitor to America's best research laboratories.

Such is the Spirit of Progress !

View of Works from Town Hall 1927



Works Development



Argon Gas Plant

Laboratories 1927

ELECTRIC LAMPS

Philips Lamps Limited, 34, Marsh Street, Bristol.
Telephone : 2746. Telegrams : Phillamps Bristol.
Philips Lamps Limited, 65, Barwick Street, Birmingham.
Telephone : 1363. Telegrams : Phillamps Birmingham.
Philips Lamps Limited, Baltic Chambers, 102, Holm Street, Glasgow.
Telephone : Central 2300. Telegrams : Phillamper Glasgow.
Philips Lamps Limited, 27, Womanby Street, Cardiff.
Telephone : 7540. Telegrams : Phillamps Cardiff.
Philips Lamps Limited, 16, Clarence Street, Belfast.
Telephone : 6830. Telegrams : Phillamps Belfast.

145, Charing Cross Road, London, W.C.2

in the cap. Mr. Harris remarked that this might bring to mind the old type pear-shape vacuum lamp, with two visible filaments, but the "Duo - Savelite" lamp is fitted with a round opal bulb, offering complete diffusion of both intensities, and an extremely pleasing appearance.

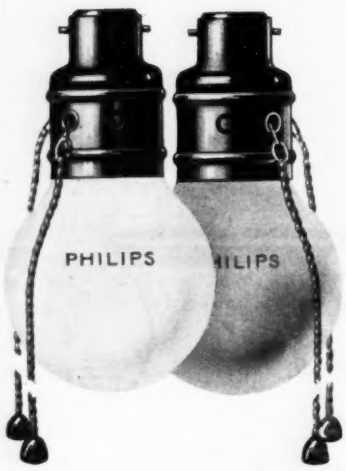


FIG. 7.—The "Duo-Savelite" Lamp.

THE BENJAMIN "ONE-PIECE" REFLECTOR.

Mr. G. HERBERT (Benjamin Electric Ltd.) exhibited and described the new Benjamin "one-piece" reflector. He explained that the chief features of this reflector were as follows:—

(1) It was scientifically perfect in design, so far as was consistent with commercial production.

(2) It was also mechanically perfect, owing to the absence of any "join" in the metal, which rendered possible a continuous coating of vitreous enamel on the steel surface, and prevented corrosion from moisture, fumes and smoke.

(3) The maximum distribution of light is obtained in zones up to the angle of cut-off of 20° below the horizontal; the maximum intensity occurs in zones from 0° to 45°.

(4) It complies with the requirements in regard to avoidance of glare specified by the Home Office Departmental Committee on Lighting in Factories and Workshops.

(5) It is in accordance with the specification issued by the British Engineering Standards Association for Industrial Lighting Reflectors.

In addition, owing to its durable nature and resistance to corrosion, it reduces the cost of maintenance involved in keeping an installation in an efficient condition to an absolute minimum.

Mr. Herbert drew attention to the design of the new top to the R.L.M. reflector and the special detachable top provided with the one-piece reflector, which greatly simplified wiring requirements. He also exhibited the new "Distributing Rodalux" unit, which utilizes a circular reflector, in which grooves characteristic of the ordinary Rodalux reflector are embodied. He pointed out that the distribution of light from such units was specially suitable for installation where lighting units are staggered, facilitating provision of uniform illumination between posts.

THE "TYPERLITE" FITTING.

Mr. H. F. SIMON (The "Typerlite" Company) exhibited several models of the "Typerlite," which is an adjustable and specially designed standard for use with typewriters, billing, adding and similar office machines. The apparatus is designed to give ample illumination just where it is wanted, and free from inconvenient shadows. A variety of bases is now being supplied which enables the appliance to be readily converted into a desk standard, wall fitting, or "clamp on" fitting, so that it has become a species of "general utility" fitting.

Mr. Simon explained that this type of fitting was proving very popular as a supplement to office lighting, and as it was only fitted with a 15-watt lamp the economy in current was very considerable—especially for an office where a large number of machines are in constant use.

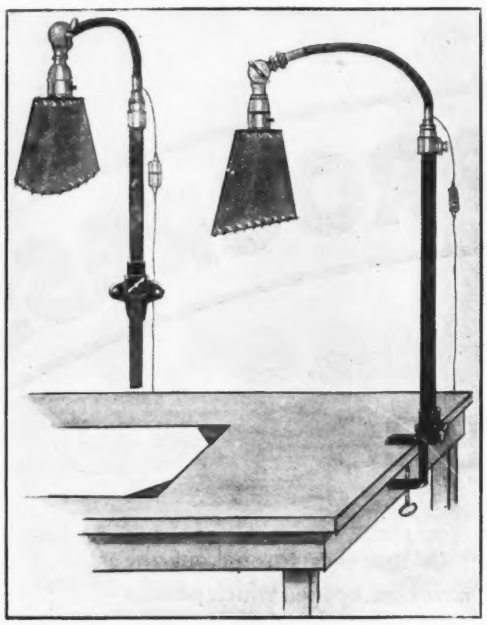


FIG. 8.—The "Typerlite" Fitting in Use.

A feature emphasized by Mr. Simon is the extreme ease with which the apparatus can be set up or dismantled.

THREE-PLY ILLUMINATING GLASSWARE.

Mr. E. FRANCIS (Wholesale Fittings Co. Ltd.) exhibited some examples of three-ply "Supastone" illuminating glassware. This glassware was made as follows: The inside is a thin layer of opal, outside there are two layers of clear glass—an arrangement which had proved beneficial in giving minimum of absorption of light, combined with absence of glare.

The specimen shown was something quite distinctive and different in type from the ordinary standard enclosed unit. It was often found that the owner of a premises desired to have a system of lighting different from that of his competitors, and the design shown satisfied this requirement. This unit was made in two sizes, 10 inches (shown plain) and 12 inches (shown decorated). However, both sizes could be supplied in either the plain or the decorated type. The 10-inch unit was intended for 150-watt gas-filled lamps, the 12-inch type for 20-watt gas-filled lamps. The canopies of these units were

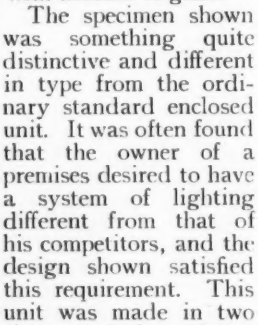


FIG. 9.—A Simple Form of "Supastone" Shade.

FIG. 10.—Typical "Supastone" Enclosed Fitting.

white-enamelled inside, so that they served as reflectors. Mr. Francis, in conclusion, showed in succession a 60-watt Pearl lamp equipped with an ordinary 9-inch opal conical shade and a similar lamp in a "Supastone" unit. He thought they would agree that there was no doubt regarding the superior brightness and appearance in the latter case.

A New Show-Window Lighting Reflector.

Mr. H. H. Long (Metro-Vick Supplies Ltd.) exhibited and described a new form of reflector (the "Met-Vick Ray"), which was specially adapted to shop-window lighting, and which, whilst moderate in price, eliminated the defects of the cheaper types of reflectors commonly used for this purpose.

He pointed out that this reflector, whilst possessing a high efficiency, was practically unbreakable and had a reflecting surface, buffed on solid aluminium, which did not peel. The actual reflecting surface was protected by a thin film of hard glass lacquer, and was very easy to adjust and fix. The reflector was at present designed for 100- and 150-watt lamps and gave a maximum

Fig. 11.—The "Met-Vick Ray" Reflector.

candle-power of 1,800 at an angle of 25° from the vertical. When "Pearl" lamps were used a somewhat softer light was obtained, and the beam was naturally somewhat "spread," but the maximum candle-power available was still about 1,400. By using a reflector of this type practically all the lighting was directed into the window, but it was sometimes expedient, with open-back windows, for a pelmet to be hung behind so as to prevent the bright surface of the reflector proving distracting to persons inside the shop.

The Ultra-Violet Testing Cabinet.

This interesting device was shown by Mr. L. H. Millar (Kelvin, Bottomley & Baird Ltd.) at the conclusion of the display, and was arranged in a specially darkened room. The beautiful effects of fluorescence demonstrated by the aid of the cabinet proved of great interest to those present.

Mr. Millar prefaced his demonstration by giving a brief explanation of the nature of ultra-violet light, recalling that whilst Newton named the colours of the spectrum in 1666 it was not until 1800 that Herschel demonstrated the existence of rays beyond the extreme visible red, whilst the discovery of the rays beyond the extreme visible violet was made by Ritter a year later.

The ultra-violet region was generally considered to commence beyond 4,000 A.U., and extended to rays of extremely short wavelength, of 2,000 A.U. or less. These short-wave rays excited fluorescence in many materials, and advantage was taken of this fact in the ultra-violet testing cabinet, which consists essentially of a box containing a quartz-tube mercury-vapour lamp screened by a special glass which allowed the ultra-violet rays to pass, but absorbed almost all the visible rays. Hence when various objects were placed in the cabinet more or less strong fluorescence was seen, and they glowed in the dark in various colours.

This fluorescence enabled one to detect many effects and conditions inappreciable by visible light, and therefore furnished the chemist and physiologist with a new method of analysis. Thus, by ultra-violet light the existence of spores and mildew, invisible by ordinary light, became surprisingly evident. Advantage was taken of this fact in examining many materials used in the woollen and textile industries, in tobacco manufacture, etc. Similarly, by the ultra-violet test chemists could detect minute impurities in materials sold as 100 per cent. pure. It had been shown that the test was sensitive to a trace of arsenic estimated at one ten-millionth of a gram—an amount quite inappreciable by ordinary chemical methods.

In hospitals and welfare clinics the ultra-violet cabinet was already becoming a part of departmental routine. By its aid the presence of ringworm, a fungoid growth, could be readily detected. This effected a great saving of time, as the necessity of making cultures from the hair believed to be infected was avoided.

In conclusion, reference was also made to other applications of ultra-violet rays, for example in testing the fastness of dyes, in promoting the sterilization of wounds and burns, and in the ultra-violet microscope recently applied to cancer research. The general use of ultra-violet light for the treatment of disease was another wide field, and special reference might be made to the improvement in the vitamin content of foods promoted by exposure to ultra-violet rays.

The "Holdrite" Suspension Device.

Mr. E. W. Stockwell briefly explained and demonstrated the simple and ingenious "Holdrite" suspension device recently introduced by Messrs. Falk, Stadelmann & Co. Ltd. The chief feature of this device is that it operates without any screws, the globe being sustained by two semi-circular saddles. Hence the upper canopy with the lamp can be easily removed, and opportunity is afforded for cleaning the glass without removing the globe or glass ware from its hangings. Other advantages of the device are (1) it will fit any shape of lip, (2) it allows for variations in contour of lip and size of flange, and (3) it surrounds the flange equally all round without undue pressure, and allows for the free expansion of the glass through heat. In spite of the easy access to the fittings, the arrangement is stated to be practically dustproof.

It was generally agreed that the display had been a varied and interesting one, and at the conclusion of the meeting a very cordial vote of thanks to exhibitors was carried with acclamation.

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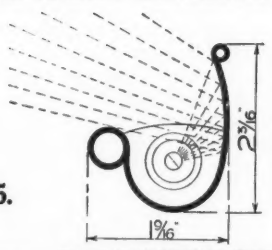
Reg. Trade Mark
CORNICE LIGHTING.



Standard Types of Reflectors for all purposes.

Send for LIST No. 25.

Sole Manufacturers:— **Type "J" REFLECTOR.**
A. W. BEUTTELL, LTD.,
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Gas Lighting

Twenty Years of Progress

ONE hundred and twenty years ago a Mr. Hyde advertised a series of lectures on "The Danger of Gas Lights," in which he claimed to prove "by the most unerring and conclusive Experiments the Evils that must inevitably result from the introduction of Gas Lights." This was part of a campaign against an irrepressible exploiter—a Moravian by birth and a vagabond by nature—F. A. Winsor, who had, a year or so previously, lighted a portion of Pall Mall by gas and found a sufficient body of supporters ready to form a company and seek a charter for it. Napoleon, hearing of the project, described it as *une grande folie*. Sir Walter Scott wrote to a friend, "There is a madman proposing to light London with—what do you think? Why, with smoke."

It took four years to fight such opposition before the Chartered Gas, Light and Coke Company was finally established. Thenceforth, however, history moves quickly. Westminster Bridge was lighted by gas lamps in December, 1813, and within a few years not only London generally but most of the large provincial towns adopted the new illuminant for streets and public buildings. Years of steady development passed by, and in 1855 a German chemist, Von Bunsen, invented the burner which still bears his name. It opened up entirely new fields for gaseous fuel. A few years later, when a new rival, electricity, threatened the loss of the gas-lighting business, the new invention must indeed have been a comfort to the older industry.

Von Welsbach's Discovery.—Even in the early 'eighties, however, when Robert Louis Stevenson took up his pen and wrote "A Plea for Gas Lamps," it must have seemed as if there was no future for gas lighting. These fears were, however, dispelled by a new discovery. In the very laboratories at Heidelberg in which Von Bunsen had worked 30 years before, a pupil of his, afterwards famous as Von Welsbach, was boiling some rare earths in a glass vessel placed on an asbestos sheet. The contents accidentally boiled over and glowed on the asbestos with a brilliant incandescence. The principle of the incandescent mantle had been found. By 1890 Welsbach mantles were in common use, and a long series of improvements served rapidly to re-establish the use of gas as an illuminant.

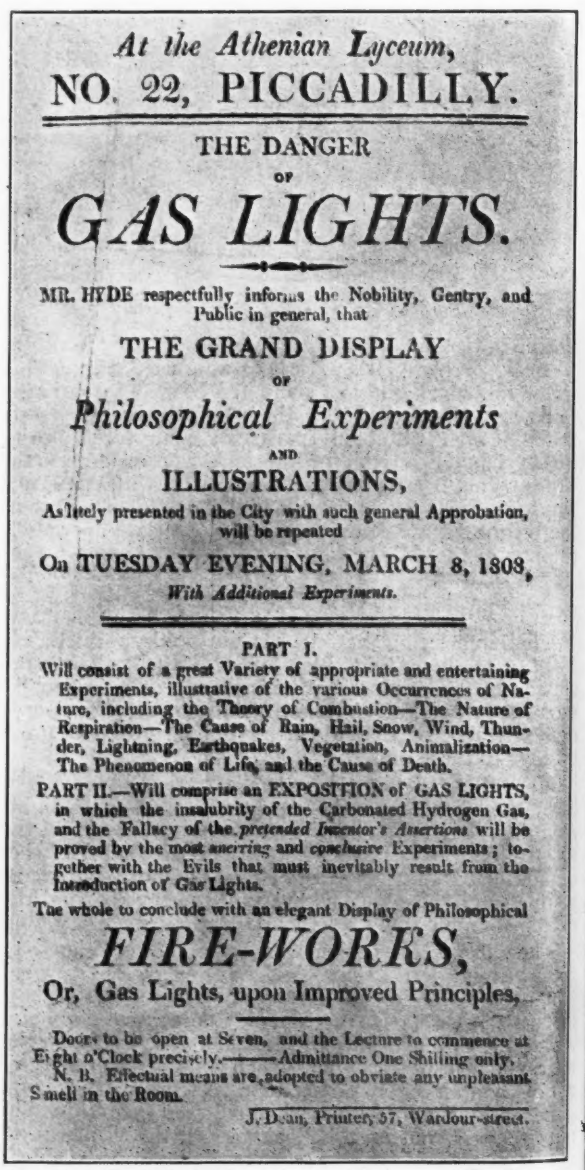
1908.—A hundred years from the date of Mr. Hyde's lectures the Journal of the Illuminating Engineering Society first saw the light of day and found gas well established as the principal illuminating agent in this country—in home, factory, shop, institution and street. But keen competition made it necessary for the gas industry not to rest on its laurels.

The British Commercial Gas Association.—A fresh movement, which had for long been quietly maturing, came prominently before the public in 1912, the industry's centenary, when a new body, known as the British Commercial Gas Association, held its first annual conference. This event, which took place at Manchester, serves to mark the most important of recent general developments in the gas industry—its organized co-operation for the purpose, broadly speaking, of placing the industry in a new relation to the community it serves.

By co-operative publicity of an educational character, by sales organization, by the training of its employees, and by scientific research on the broadest lines, the gas industry set out as a united body, acting through elected representatives, to take up to the full, as no other industry had done, the great responsibility which devolves on all public utilities.

The National Gas Council.—A great change in the outlook of all industry towards its national responsibility was everywhere occasioned by the war. In the gas industry, which already possessed an organization specifically devoted to improving and extending its service to the nation, this led not indeed to a change but to an intensification of its activities. During the war there came into existence another new organization whose function was, and is, to centralize the Parliamentary work of the whole industry. This was the National Gas Council. This Council has been responsible for Parliamentary and other work of a far-reaching nature, among the most important of which, so far, has been its success in securing the passage through Parliament of the Gas Regulation Act (1920), to which reference will be made later.

The Therm.—The advent of the incandescent gas burner, which depends for its efficiency not on the "illuminating power" of the gas it consumes but on the temperature to which the mantle can be raised by a non-luminous gas flame, made obsolete many of the methods which had previously been adopted in the manufacture of gas and the standards by which its quality was tested. In 1916 the Gas (Standard of Calorific Power) Act was passed, enabling a gas undertaking to apply in certain circumstances to the Local Government Board or the Board of Trade for an order substituting a calorific for an illuminating standard. This change of standard was thoroughly sound so far as it went, but, unfortunately, in its application under the existing regulations it stopped short of logical completeness, for though these regulations stipulated that



At the Athenian Lyceum,
NO. 22, PICCADILLY.

THE DANGER
OF
GAS LIGHTS.

MR. HYDE respectfully informs the Nobility, Gentry, and Public in general, that

THE GRAND DISPLAY
OF
Philosophical Experiments
AND
ILLUSTRATIONS,

As lately presented in the City with such general Approbation, will be repeated

On TUESDAY EVENING, MARCH 8, 1808,
With Additional Experiments.

PART I.

Will consist of a great Variety of appropriate and entertaining Experiments, illustrative of the various Occurrences of Nature, including the Theory of Combustion—The Nature of Respiration—The Cause of Rain, Hail, Snow, Wind, Thunder, Lightning, Earthquakes, Vegetation, Animalization—The Phenomenon of Life, and the Cause of Death.

PART II.—Will comprise an EXPOSITION of GAS LIGHTS, in which the insalubrity of the Carbonated Hydrogen Gas, and the Fallacy of the *pretended Inventor's Assertions* will be proved by the most *unerring* and *conclusive* Experiments; together with the Evils that must inevitably result from the Introduction of Gas Lights.

The whole to conclude with an elegant Display of Philosophical

FIRE-WORKS,

Or, Gas Lights, upon Improved Principles.

Doors to be open at Seven, and the Lecture to commence at Eight o'Clock precisely.——Admittance One Shilling only.

N. B. Effectual means are adopted to obviate any unpleasant Smell in the Room.

J. Dean, Printer, 57, Wardour-street.

FIG. 1.—A Handbill of 1808 announcing a lecture on "The Danger of Gas Lights."

the gas supplied was to be of a certain calorific value per cubic foot no attempt was made to call the attention of consumers generally to the meaning and significance of the change of standard, and as they still continued to pay for the gas which had passed through their meters at the rate of so much per 1,000 cubic feet they were quite unable to judge if they were getting better or worse value for their money. These considerations led to the formulation of the scheme of charging for gas by the "therm" instead of by the thousand cubic feet, the "therm" being the name adopted for 100,000 British Thermal Units. Although the alteration in the system of paying for gas met with some antagonism at the outset that antagonism quickly died down when the general public came to understand the system and found that, under the regulations imposed by the Gas Regulation Act of 1920, they are now buying a perfectly definite commodity, of declared and tested quality and value, at a definite price.

A New Start for the Gas Industry.—The Gas Regulation Act, which protected the consumer in the manner indicated, also conferred a great boon on the gas industry. It put an end to the disastrous financial position occasioned by the war. One of the principal effects of the war was to raise enormously the cost of materials and labour, with the result that gas undertakings correspondingly had to increase the price of gas, and to such an extent that many of them under their sliding scale or maximum price clauses were unable to pay any dividend on their ordinary stock, or at the most a dividend at a very low rate. Although the gas undertakings were of inestimable service to the country during the war, as was publicly acknowledged by the late Lord Moulton, the Government were only able, before the Act was passed, to give very meagre relief to the industry, with the result that it would have been impossible for gas undertakings to raise fresh capital required for extensions or plant, or, indeed, to have continued to carry on business. The Act enabled them to adjust their powers of charging to the altered circumstances, and at the same time protected the consumer both by compelling the Board of Trade to give careful attention to all objections laid before them before making any order and by enabling consumers or local authorities to obtain revisions of the standard price from the Board of Trade if circumstances render it desirable.

Gas at the British Empire Exhibition.—These notes would be incomplete without brief reference to the British Empire Exhibition. There the manifold service of gas was exemplified in an unmistakable manner. The British Empire Gas Exhibit, in its pavilion occupying 12,000 square feet, was one of the great attractions of the Palace of Industry. To its influence on the minds of the public can be traced much of the success of the gas industry during the ensuing years. Gas was used extensively for power, heating, lighting and water heating in many of the exhibits, and for all of the cooking and water-heating operations in the 50 large restaurants of Messrs. J. Lyons and Company, the sole caterers for the exhibition. The amusements park, in which 96 per cent. of the visitors congregated after dusk, was lighted by a large number of low-pressure inverted incandescent gas lamps, each with a cluster of 16 small mantles. This imposing installation was given a trial run two days before the opening of the exhibition and was unfailingly in operation every night during the run of the exhibition—a typical example of the reliability of gas. An official of the amusements park, with whom the lighting of these two miles of streets was arranged, remarked, "There is one thing in our section that has never given me a minute's anxiety, and that is the gas lighting."

Developments in Gas Lighting.—With this brief outline of the history of the gas industry during the past 20 years, we may pass on to consider the developments in gas lighting during the same period. For this purpose we cannot go to a better authority than Mr. Robert Watson, one of the most enthusiastic supporters of the Illuminating Engineering Society. From an able paper read by him a few years ago most of the following notes are abstracted.

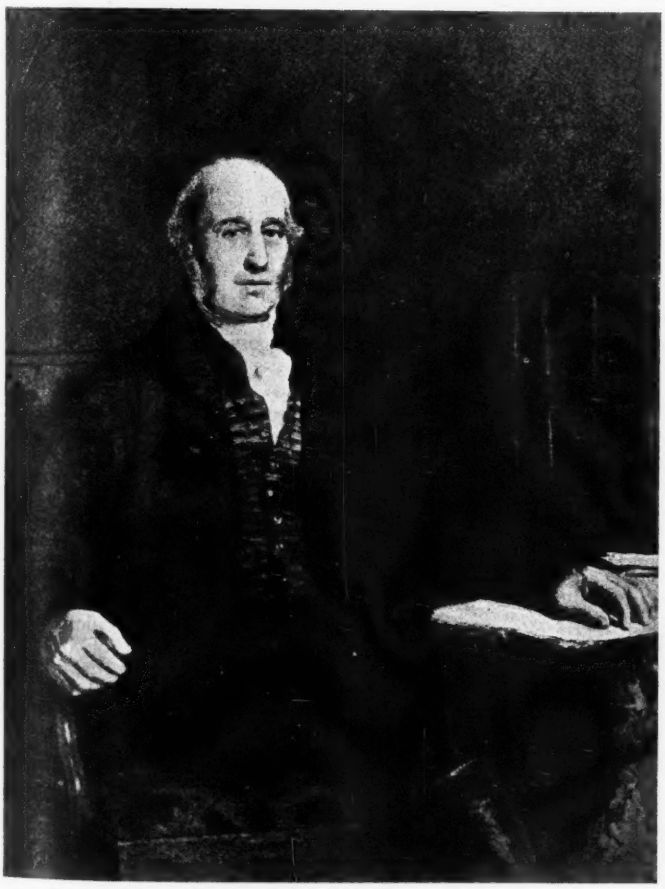


FIG. 2.—William Murdoch (1754—1839), the strongest claimant to the title "Inventor of Gas Lighting."

The mantle employed in the early stages of incandescent gas lighting was not altogether satisfactory, but investigation and research paved the way to, and ultimately effected, such marked improvements in the composition of the material and in the strength of the mantle that incandescent gas lighting became firmly established in the public favour.

The Inverted Mantle Introduced.—About the year 1900 some genius conceived the idea of inverting the burner, and although there were doubts as to the possibility of getting a satisfactory flame shape with the required full incandescence of the mantle, the experiment proved finally a success. For many reasons the inverted began to displace the vertical type of burner, and is now the universally accepted method of incandescent gas lighting.

The reasons referred to are several, and each of them is good. The light, for instance, is thrown downwards in the direction usually required. The mantle, by virtue of its size, structure and method of support, is stronger and more durable. That it easily withstands vibration is proved by the simple fact of its use in railway train gas lighting. The luminous efficiency is higher as a result not only of a smaller and more concentrated flame, but also of some, although at first unintentional, preheating of the gas before ignition, thereby producing a hotter flame and greater incandescence of the mantle. The mantle fits the flame better and can be brought into full use.

Superheated Incandescent Burners.—Progress in the development of gas lighting, as in other phases of industrial activity, was undoubtedly retarded during the war and its aftermath, but nevertheless some advance was made, and the past few years have seen the introduction and use of what is known as the superheater incandescent gas burner.

The efficiency and economy of the superheater type of burner are derived from the several

important factors in its construction. Some suggestion has already been made that the increased illumination obtained from the inverted burner was partly due to the fact that the gas feeding downwards was subjected to the heat of the flame. This advantageous effect was accidental, but in the case of the superheater burner it is sought for and accentuated. The gas and air mixture of the bunsen flame is preheated by being passed through a small, but scarcely noticeable, chamber placed immediately over the burner, and such preheating results in a high flame temperature with greater incandescence of the mantle surface. The proportion of air and gas is governed by a single and very simple regulator. The mantles are much smaller than those of the usual type, and they fit the flame even better, thus ensuring full service from the whole of the mantle structure. The small mantles have the further advantage of additional strength, and renewals are therefore infrequent.

High-pressure Lighting.—While the gas industry is thus in a position to offer excellent and cheap methods of lighting by the superheater types of the incandescent burner, working on ordinary gas pressures, the claims of high-pressure lighting are both important and considerable, including as they do greater lighting efficiencies and lower costs. This system is well known, having been in use many years. High-pressure gas lighting is obviously suited chiefly to large buildings, works, shops and areas. In these cases extensive illumination and high foot-candle values are needed, and the required number of burners for general lighting warrants the installation of the special, although simple and small, plant consisting of a mechanically driven compressor necessary for raising gas pressures.

The efficiency of the method is due to the fact that the supply of the gas, or in some cases of the air, under high pressure induces increased velocity of the gas flow and complete admixture of the gas and air, resulting in a very high flame temperature and full incandescence of the mantle. The velocity of the gas in itself helps to keep the burner nipples free from the dust which is found in some factories. The units of light usually employed in factory work are 100, 150, and 300 candle-power, but lamps running up to 4,500 candle-power can be, and are, employed for large spaces. Lamps of 2,000 and 3,000 candle-power are in use in many of the main streets of London and the provinces.

The Franco-British Exhibition, held at the White City in 1908, gave a great opportunity for the introduction of what was then a new high-pressure gas lamp. It was installed in the grounds in great numbers, and is remembered to-day for the brilliance of the display and the very satisfactory character of the lighting obtained.

Parade Lighting.—About 1910 what is known as a co-operative system of lighting for shops and parades became very popular. Many gas companies undertook to provide and erect lamps of a standardized design and power, to supply gas and to carry out maintenance for an inclusive sum. Many thousands of high-pressure gas lamps were installed in the next few years for these and other purposes.

During the war, when lighting restrictions had to be observed, the numbers of high-pressure lamps in use were reduced, and later the introduction of "summer time" interfered somewhat with the continuation and extension of this co-operative system of shop lighting; but this class of lighting has become so well established that it is still a feature in important shopping districts of London and in many cities and towns in the provinces. A large number of cinemas depend on this brilliant and reliable source of illumination for the lighting of their exteriors, and to-day, owing to the call for better lighting, a fresh demand is arising for powerful lamps.

Ventilating Lights.—The ventilating possibilities of gas have produced quite a number of excellent ceiling lamps which afford ample and well-diffused light and at the same time directly help, by means of ceiling outlets, in the circulation of the air. Ceiling gas ventilators have been adopted in many large buildings, such as theatres and halls, with great satisfaction to those concerned.

It will thus be seen that during the last 20 years a considerable variety of both high-pressure and low-pressure (superheater) gas lamps and burners have been made available for general and local lighting. These can be used for the direct or semi-indirect method of illumination, according to choice or the place to be treated.

Gas Lighting, Direct and Indirect.—The direct method is usually adopted, and is the more economical since practically the whole of the light is available and the illumination is not dependent on the varied reflective power of ceiling and walls. Direct light sources properly placed and shaded are quite satisfactory. Shades and reflectors suitable for the protection of the eyes are varied in character and can be obtained for every requirement, whether it be the softening and general diffusion of the light, or its deflection in specific directions, or the combination of these effects. From the point of view of decoration the choice is considerable, but it should be borne in mind that obscuration is to be avoided, and there is no necessity to use, say, heavily frosted, coloured or thick opal glass, which causes distinct loss of light. Glassware of the Holophane or prismatic type is particularly useful since it materially helps in the prevention of dazzling effect and is excellent for both diffusing and distributing the light rays. For factory illumination metallic enamelled reflectors and shades are usually employed for the purpose of directing the light where wanted. The light sources are generally high enough to avoid trouble, but where this is not the case they are well screened by reflectors, or clear globes with opal bands equal in depth to the length of mantle are provided.

The purely indirect system of lighting, whereby the illumination is obtained by reflection, is expensive whatever illuminant is employed, and it presupposes, and indeed necessitates, light-coloured ceilings and walls to ensure effective illumination.

The semi-indirect method of illumination has the advantage of being less wasteful of light and virtually combines the merits of both the direct and indirect systems. Gas burner clusters, shaded by translucent bowls which allow a certain amount of light to be diffused downwards and fitted overhead with reflectors from which the greater portion of the light is distributed throughout the room, yield effective and agreeable illumination. The method can be thoroughly recommended where the conditions call for it, and it is particularly adapted for the illumination of offices, shops, showrooms and similar places.

Silica Ware.—At this point it may be profitable to refer to the introduction of heat-resisting shades and globes of the vitreosil or silica type. The advantages afforded by the silica cup of high-pressure gas lamps can now be secured for low-pressure or ordinary lighting purposes. This ware, unlike ordinary glass, is practically unbreakable by the heat of the flame. The material is not absolutely transparent, and its opalescence guards the eye from any direct ray brilliancy. The ware is suitable for all lighting purposes, both direct and semi-indirect, and yields an exceedingly pleasant illumination of a colour which is restful to the eye. The direct loss of light through vitreosil glass is small and estimated at about 10 per cent., but against this is the gain due to the excellent diffusion obtained.

Distance Control.—Gas lighting may now be regarded as convenient from the point of view of control. It may be that it will be some time before the match for lighting purposes is dispensed with, especially where only one or a few burners are in use, but the possibility of its abolition for larger installations is now assured.

The incandescent burner fitted with a by-pass light has been long in use, and is for single burners or lamps quite good. The gas consumption of the pilot light is very small, and the existence of the bead of light gives some semblance of welcome on entering a room. The subject of switch lighting has been one which has led to the exercise of a good deal of ingenuity, and various devices successively improved are available.

The pneumatic valve and switch and also the Norwich system of distant gas lighting have received some favour for ordinary lighting purposes and appear to work well. Without any desire to particularize it may be useful to draw attention to other methods eminently suitable for the lighting of churches, halls, schools, shops, shop interiors and like buildings and making an excellent adjunct to semi-indirect lighting installations. These are equally applicable to the low-pressure lighting of factories and workshops, much in the same way as the existent method for high-pressure lighting and extinguishing. The apparatus consists of a control cock placed where required in the line of existing piping and an automatic diaphragm governor with small bypass light connected with the burner or lamp. The system permits of the lighting and extinguishing of any number of lights by a single tap fixed in a convenient position, and has the further advantage of being cheaper than the older mercurial type of appliance. Mr. H. Talbot, in his paper read on the 22nd November, at the opening meeting for 1927–28 of the Illuminating Engineering Society, called attention to "the astonishing progress in the use of automatic controllers for lighting and extinguishing street lamps."

With this record of developments which have taken place, mainly during the lifetime of the Journal of the Illuminating Engineering Society, it is not surprising to learn that Whitehall and many of the principal streets in London and the provinces, as well as the parades on some of our most noted seaside health resorts, depend on this reliable illuminating agent. As indicating the present-day prospects for the sale of gas-lighting fittings for domestic and general lighting purposes it may be mentioned that a recent campaign by one gas undertaking with just under 50,000 consumers resulted in the sale during a period of only a few weeks of no fewer than 30,000 new gas burners.

With this in mind it is no matter for surprise to find that, despite the remarkable growth in the demand for gas for heating, cooking, water heating, power and industrial purposes, many gas undertakings still depend on the "lighting" load for a very substantial portion of their business.

An Optimistic Industry.—For 116 years now gas has lighted London's streets, and it still lights the major portion of them. It is providing light (and incidentally warmth and ventilation) in the homes of millions. The year 1928 finds gas, like another well-advertised commodity, "still going strong."

FIG. 3.—Regent Street, now one of the finest thoroughfares in the world, is lighted (and has for the last 15 years been lighted) by high-pressure gas lamps, some of 3,000 candle-power, others of 4,500 candle-power. Two of the 18 lamps can be seen in this photograph, which was taken when Their Majesties the King and Queen drove through Regent Street on the occasion of its reopening on the 23rd June, 1927.

Sheffield Illumination Society

We have received a copy of the syllabus for 1928 of the Sheffield Illuminating Society. This embraces the following lectures:—"Time Switches" by Mr. E. E. Sharp, of Venner Time Switches, Ltd. (Jan. 10th); "A Talk on Lighting Topics" by Mr. G. Sawyer, of the Lighting Department (Feb. 13th); "Roads and Road Making" by Mr. W. J. Hadfield (Oct. 23rd).

In addition the following events have been arranged:—Social Evening at Stephenson's Restaurant, Castle Street (Jan. 20th); Visit to Messrs. Walker and Hall's (Mar. 28th); Visit to Automatic Telephone Exchange (May); Annual Excursion (June 23rd); Visit to Nunhead Colliery (Aug.); Presidential Address and Business Meeting (Dec. 12th).

Gas Sold in 1926

The Board of Trade return relating to gas undertakings in Great Britain for the year 1926, as usual, contained much interesting data. The total amount of gas sold (276,568,647 cubic feet) shows a substantial advance over the corresponding figure for 1925 (265,757,353). Of this amount approximately a third was supplied to prepayment consumers. The amount furnished for public lighting was 9,162,739 cubic feet—about 3 per cent. of the whole. Throughout the period 1920 to 1926 the total quantity of gas sold has increased steadily year by year. The sales for public lighting increased similarly during the years 1920 to 1925, but the figure for 1926 shows a diminution (about 8 per cent.). This, however, is doubtless explained by the economies exercised during the strike period. It would be interesting to know what proportion of the gas sold to ordinary and power consumers is used for lighting. Very possibly this amount would also be found to have increased progressively during the period covered, though it is sometimes suggested that propaganda during recent years has been mainly concentrated on heating and commercial applications. In any case the figures certainly serve to show the fallacy of any assumption that gas is a "dying industry."

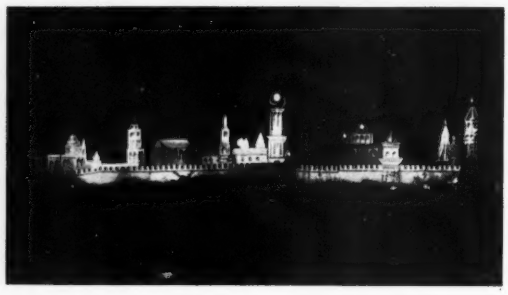
TRADE NOTES & ANNOUNCEMENTS

MILITARY TATTOO LIGHTING.

The " Burning of Moscow " presented at the recent Aldershot Tattoo, furnishes an interesting example of the utility of G.E.C. floodlight projectors and Osram gasfilled lamps.

Our illustration is from an untouched night photograph taken at approximately 1,000 yards from the objective. In this setting Captain A. J. Maine, M.I.E.E., Chief Electrical Engineer of the Aldershot Command, by whose courtesy this photograph was secured, employed no less than 36 powerful G.E.C. floodlight projectors. Many of these were equipped with colour mediums to impart single and blended colour effects on to the flames of blazing petrol sprays (and dense clouds of smoke given off by piles of burning cordite), which appeared to destroy the city. Thus floodlighting was the principal factor in this great burning scene, which was presented with so much realism and to such effect that it was difficult to realize that this apparent devastation was nothing more than a great lighting spectacle staged in the interests of military charity. The adjacent illustrations give a good idea of the effects produced.

A number of the military searchlights employed utilized G.E.C. colour mediums in the illumination of the woods around the arena, while Osram automobile lamps played a prominent part in the illuminated aeroplane display. In the numerous car parks, which in some cases extended quite two miles from the arena, many thousands of Osram lamps illuminated the hills, woods, roads, parking indicators and directional signs, while temporary bridges that were erected by the Royal Engineers to cope with the enormous road traffic were illuminated by G.E.C. Wembley lanterns.



Spectacles in connection with the " Burning of Moscow," presented at the recent Aldershot Tattoo.

A *TOO* ATTRACTIVE SHOP WINDOW.

Whilst referring to the activities of the General Electric Co. Ltd. we may also recall the recent case of the shop window in which sat a mannequin displaying silk stockings, which gave way as the result of the pressure of the crowd outside. The attractive power of the display was such that the crowd were attracted not only to but *through* the glass window—fortunately without serious injuries arising.

The incident received some attention in the daily press, but, according to information received, the full explanation of the mishap is only now revealed—the window was lighted by GECoRAY reflectors equipped with 100-watt Osram gasfilled lamps!

" THE K. & M. QUARTERLY JOURNAL."

This month we have to welcome another addition to the trade organs published by firms concerned with illumination—*The K. & M. Quarterly Journal*, published by Messrs. Korting and Mathiesen Electrical Ltd. The first issue is a creditable issue containing illustrated articles on the lighting of shop windows, industrial lighting, etc., as well as notes on the chief novelties being introduced by this firm.

In introducing this new issue it is explained that it is intended to serve for educational as well as publicity purposes, and useful information from home and abroad will be included. We shall look forward with interest to the receipt of further copies. We understand that it is proposed to issue the journal quarterly. Enquiries for copies should be addressed to Messrs. Korting & Mathiesen Electrical Ltd., 711-715, Fulham Road, London, S.W.6.

THE LIGHTING OF CHURCHES.

We have received a reprint of Mr. H. C. Wheat's recent article in *The Electrical Times* on " Church and Cathedral Lighting." The article well deserves reading—particularly the section showing how the distribution of light may make or mar the impression created by fine buildings when viewed under artificial light. Some excellent photographs illustrating the latest methods of cathedral lighting are included. We understand that the installations described were all planned by the British Thomson-Houston Co. Ltd., who also supplied the lamps and lighting equipment.

THE USE OF GAS DURING THE CHRISTMAS SEASON.

Another attractive Christmas number before us is the copy just issued of " A Thousand and One Uses for Gas." This is got up in quite an enterprising manner, the idea being to illustrate the manner in which gas adds to the warmth of Christmas hospitality—not to speak of its applications in aiding the cooking of the Christmas pudding and the storage of food over Christmas!

" THE BENJAMIN REFLECTOR."

The Christmas number of *The Benjamin Reflector* contains some further views showing the new works extensions of Benjamin Electric Ltd. at Tottenham, and on the back page there are two excellent photographs illustrating the lighting of the Carntyne Dog-racing Track at Glasgow. From all accounts these racing tracks seem to be furnishing special opportunities for the skill of the illuminating engineer.

We are interested to observe that a " Notebook on Industrial Lighting " is to be issued shortly, and applications for this little handbook should be addressed to the company at once.

LONDON ELECTRIC FIRM LTD.

Our attention is drawn to the fact that the London Electric Firm Ltd. has been making lowering gear for a period of 23 years, and we are reminded of this by the receipt of an assortment of literature showing the varied applications of lighting with which the firm is associated. Chief amongst these undoubtedly is the special raising and lowering gear, which was adopted for the central suspension street lighting in the City of London. The absence of posts is regarded as a considerable advantage in this method of lighting, especially in these days of increasing speed and volume of traffic.

Lowering gear of this description is also utilized in Hove, Chatham, Eastbourne and numerous other towns throughout the country, for both gas and electric lighting, and it has been adopted in many important buildings. A special feature is the relief of weight by the contact-suspension device, which, in combination with the self-sustaining winch, constitutes a form of apparatus which is practically " fool-proof."

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SCIENTIFICALLY DESIGNED REFLECTORS FOR INDUSTRIAL LIGHTING.

The field of industrial and commercial lighting has recently received special attention from lighting experts, and numerous useful reflectors and lighting appliances have been designed.

Amongst these, special interest attaches to the "Glassteel" Diffuser manufactured by the British Thomson Houston Co., Ltd., which is illustrated in Fig. 1. The "Glassteel" Diffuser is a lighting unit which combines the reflective efficiency of the familiar B.T.H. Mazdalux Reflector with the good diffusion of the enclosed globe, and thus represents a distinct advance. The unit is specially designed for industrial and commercial use and it possesses several notable advantages. It is claimed that "glare" is non-existent, because the opalized globe

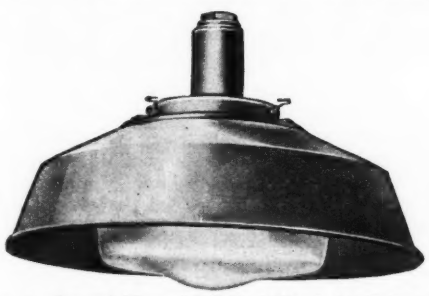
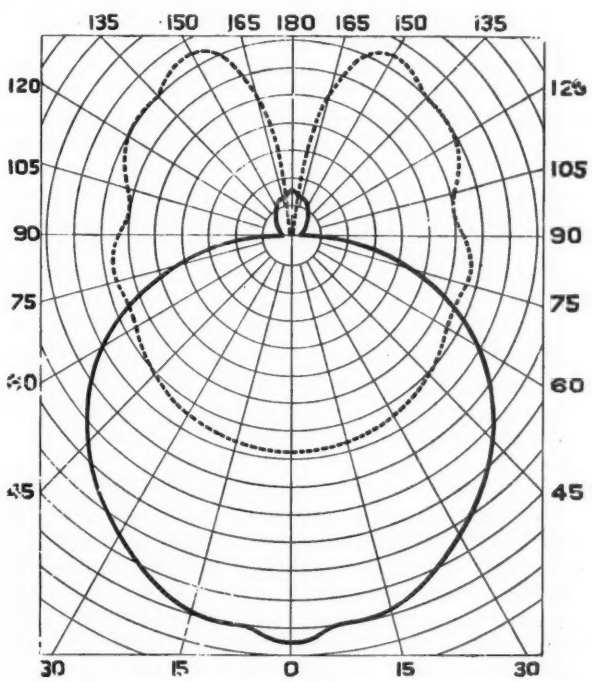


Fig. 1.—General View of B.T.H. "Glassteel" Reflector.

entirely encloses the lamp, while sharp contrasts between the lighted parts of the room and the darker ceiling are avoided by permitting a certain amount of light to reach the ceiling through apertures pierced in the top of the metal reflector. The reflector also protects the glass enclosing globe, and the likelihood of breakage is thus much reduced.

The reflector consists of vitreous enamelled steel (formed to a special contour to secure suitable distribution of light) to the upper portion of which a housing is permanently attached containing an all-porcelain lampholder. A series of perforations are provided in the upper portion of the reflector, which is also furnished with suitable gallery screws to support the globe. The complete lighting unit gives light distribution of



a "focussing-dispersing" character requiring a spacing ratio of 1¼ to 1 for any illumination. The "Glassteel" Diffuser, illustrated in Fig. 1, is white vitreous enamelled inside and grey vitreous enamelled outside. Fig. 2 shows the characteristic distribution curve of a 20-inch "Glassteel" Diffuser, using a Mazda gasfilled lamp, compared with the curve of a bare lamp.

"Glassteel" Diffusers are supplied 18 inches or 20 inches in diameter, intended respectively for Mazda gasfilled lamps of 100 to 200 watts and 300 to 500 watts.

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HOLOPHANE LTD.: ANNUAL STAFF CONFERENCE.

The Annual Conference of the indoor and outdoor staff of Holophane Limited was held recently in the conference room at their offices, Elverton Street, Westminster, S.W. Many interesting papers were read, amongst which mention should be made of Mr. Leon Gaster's report on the General Progress in Illumination during 1927, the B.E.S.A. Street-Lighting Specification by Mr. E. Stroud, Recent Installation Problems by Mr. L. M. Tye, Developments in Colour Lighting by Mr. R. G. Williams, Consideration of Ancient Lights by Mr. H. S. Allpress, a combined paper on the Lighting of Mills in the Cotton and Textile Trades by Mr. S. D. Schofield and Mr. M. C. Toner, and a Report on Temperatures Developed in Certain Types of Artificial Lighting Units by Dr. S. English.

The conference was spread over two days, and the various papers were the subject of considerable discussion and debate.

On the evening of the first day of the conference the staff held their Annual Dinner at Frascati's Restaurant.

MESSRS. HEYES AND COMPANY'S WORKS SOCIAL.

The directors of Messrs. Heyes and Co., Ltd., Water-Heyes Electrical Works, Wigan, entertained their staff and employees at a social evening held on the 22nd December at the Court Hall. The social took the form of a tea, whist drive, dance and entertainment, and was a source of enjoyment to all the guests. Among those present were Mr. W. A. Heyes (Governing Director), Mrs. W. A. Heyes, Mr. A. V. Heyes (Managing Director), Mr. O. J. Davis (Director), Mr. J. W. Cartwright (Works Manager) and Mr. J. C. Muir, F.C.I.S., A.L.A.A. (Secretary).

On the conclusion of the tea the Governing Director, Mr. W. A. Heyes, expressed his pleasure at the unanimous response to the invitation and warmly welcomed the guests, for whom the Works Manager responded.

Subsequently there was a whist drive and entertainment, including a dialect recitation, which was encored, dances, a conjuring display and a violin solo. Further dances and another recitation brought a most enjoyable evening to a close.

A PLEASING SHOP-LIGHTING INSTALLATION.

Interior View of Messrs. Hugman's Establishment at Southsea.

The installation illustrated above was executed with lighting units supplied by Messrs. Korting and Mathiesen Electrical Ltd., and constitutes a good example of diffused lighting. Attention may be drawn to the special pear-shaped units; 500-watt lamps were used on the ground floor, 100-watt units on the balcony. (The luminous area in the background, by the way, is not due to daylight but is a well glass roof receiving artificial light from above.)

CONTRACTS CLOSED.

The following contracts are announced :—

SIEMENS ELECTRIC LAMPS AND SUPPLIES LTD. :—

Post Office Stores Department; 12 months' contract for the supply of Siemens lamps for the Post Office Landon Railway.

Admiralty; for large quantities of Siemens helical traction gasfilled and vacuum lamps.

METRO-VICK SUPPLIES LTD. :—

Admiralty; for Cosmos vacuum ship-type lamps.

Director of Naval Contracts; for Cosmos vacuum shore and ship lamps and gasfilled lamps.